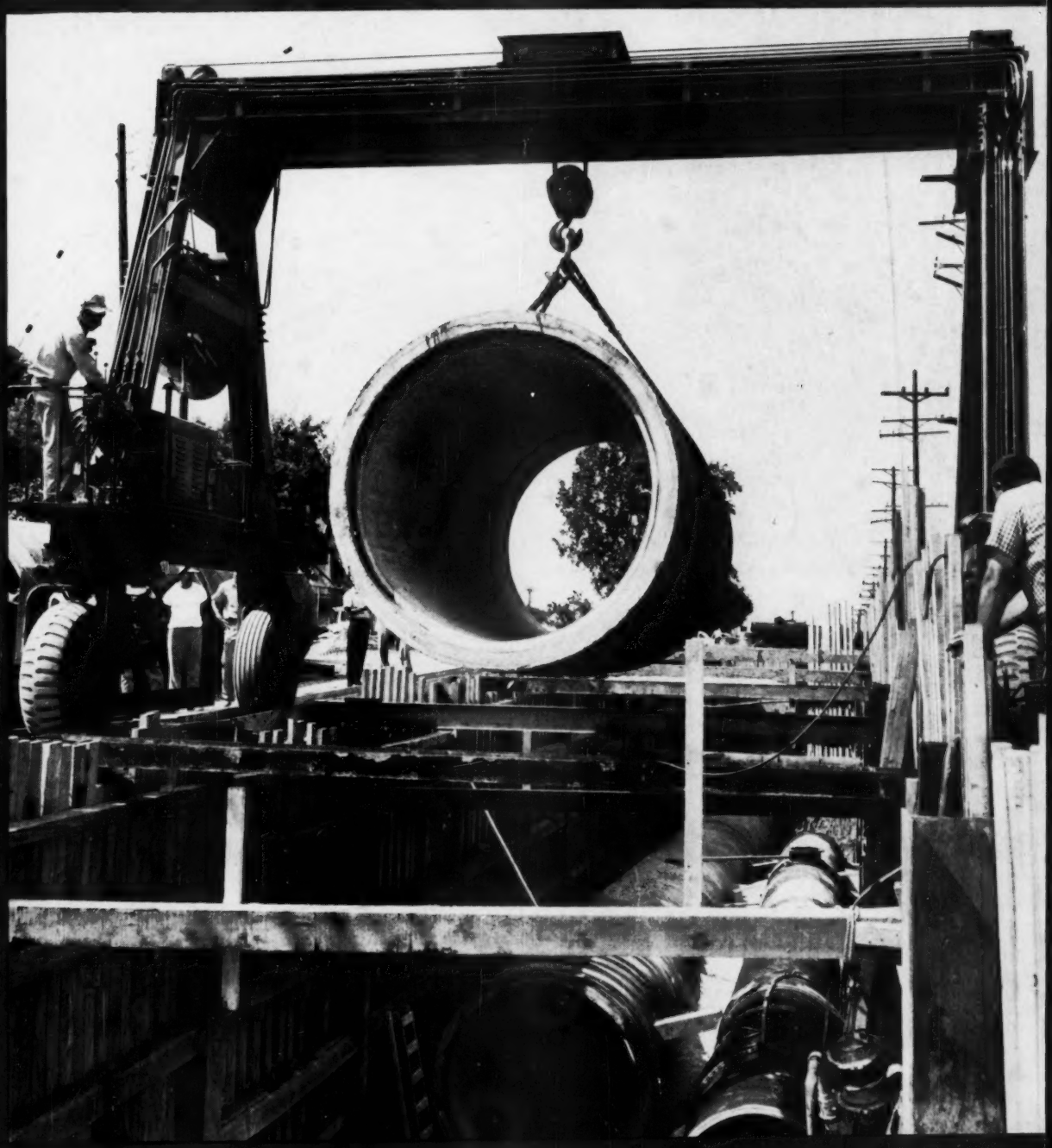
CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION • FEBRUARY 1961



Concrete pipe around the world

See page by J. A. SHAW • Table of Contents, p. 3

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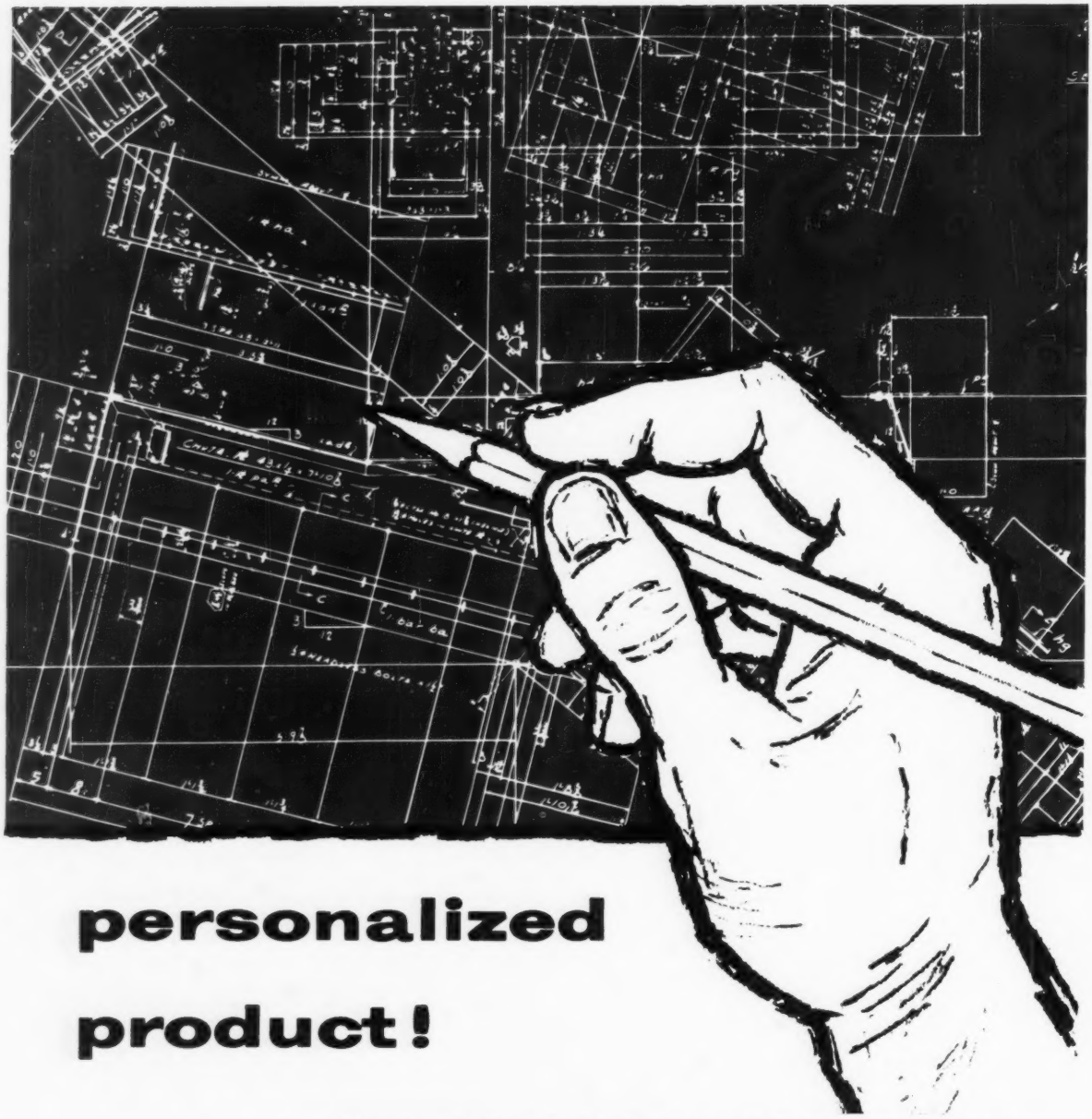

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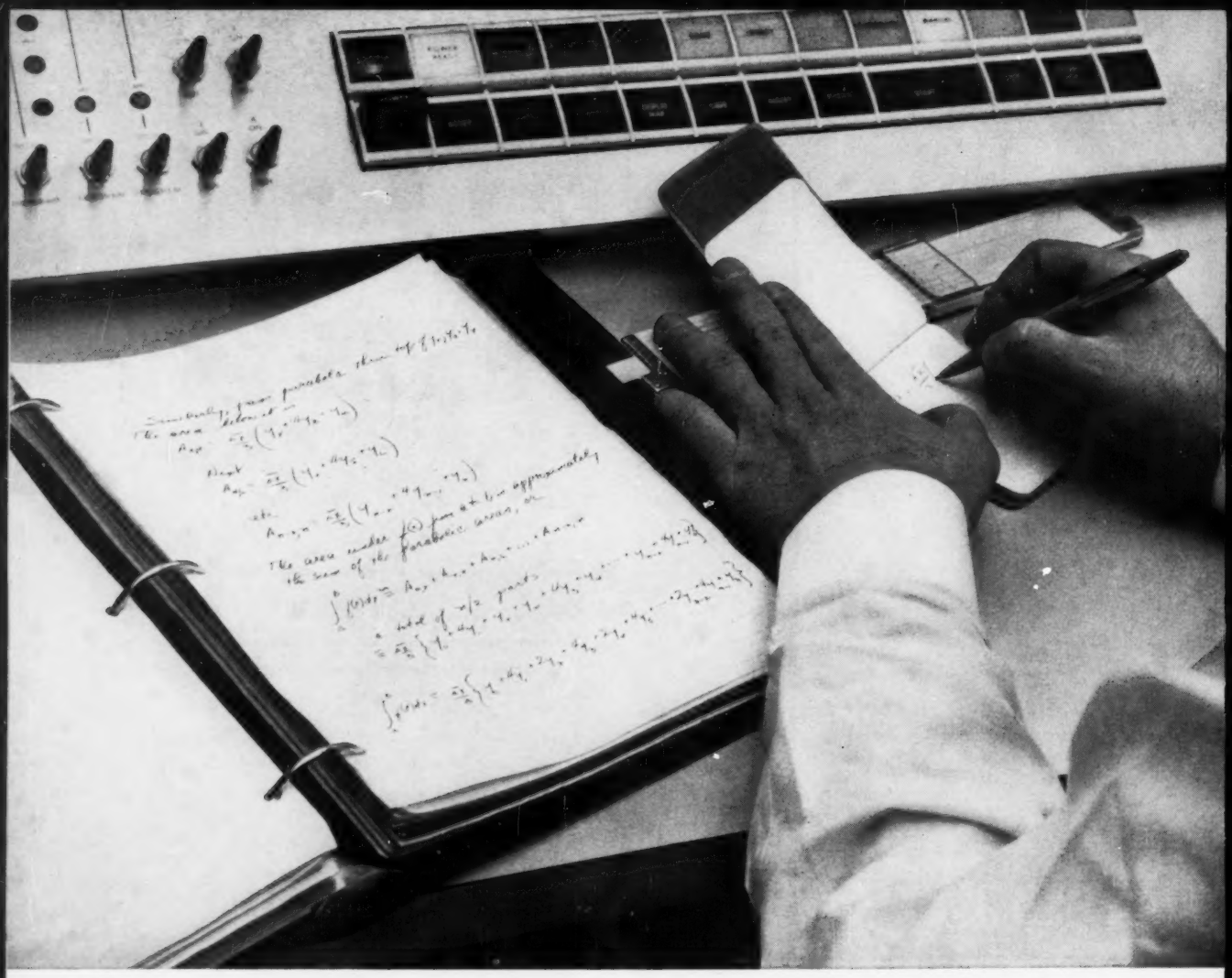

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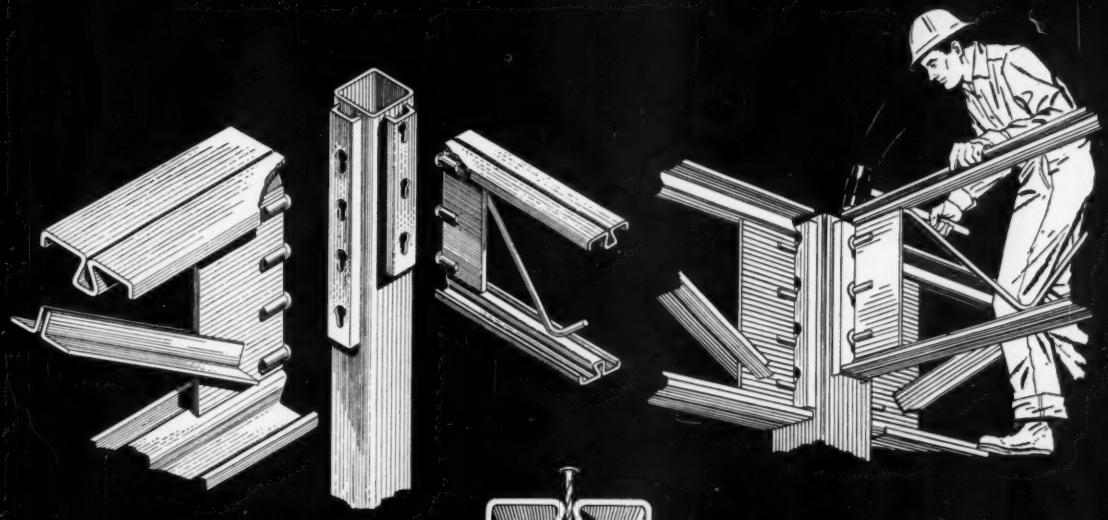

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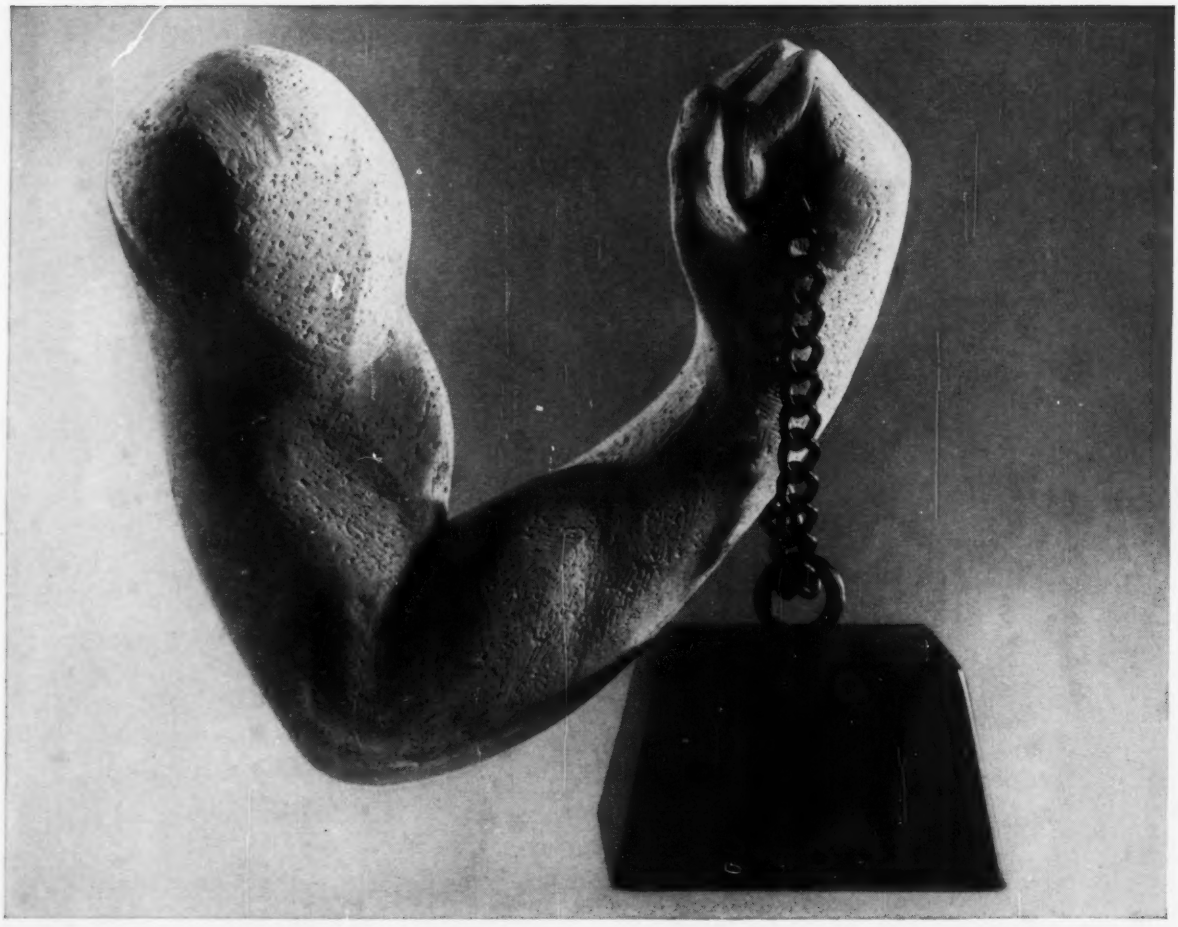

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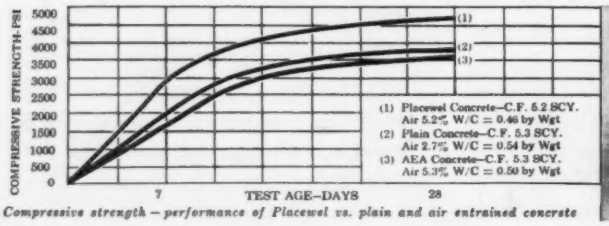
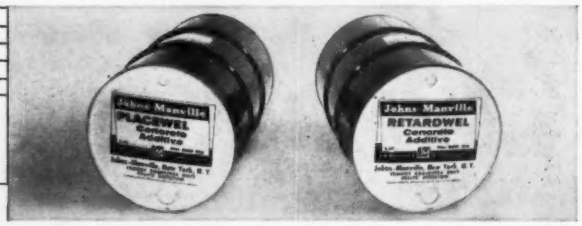


Compressive strength – performance of Placewel vs. plain and air entrained concrete



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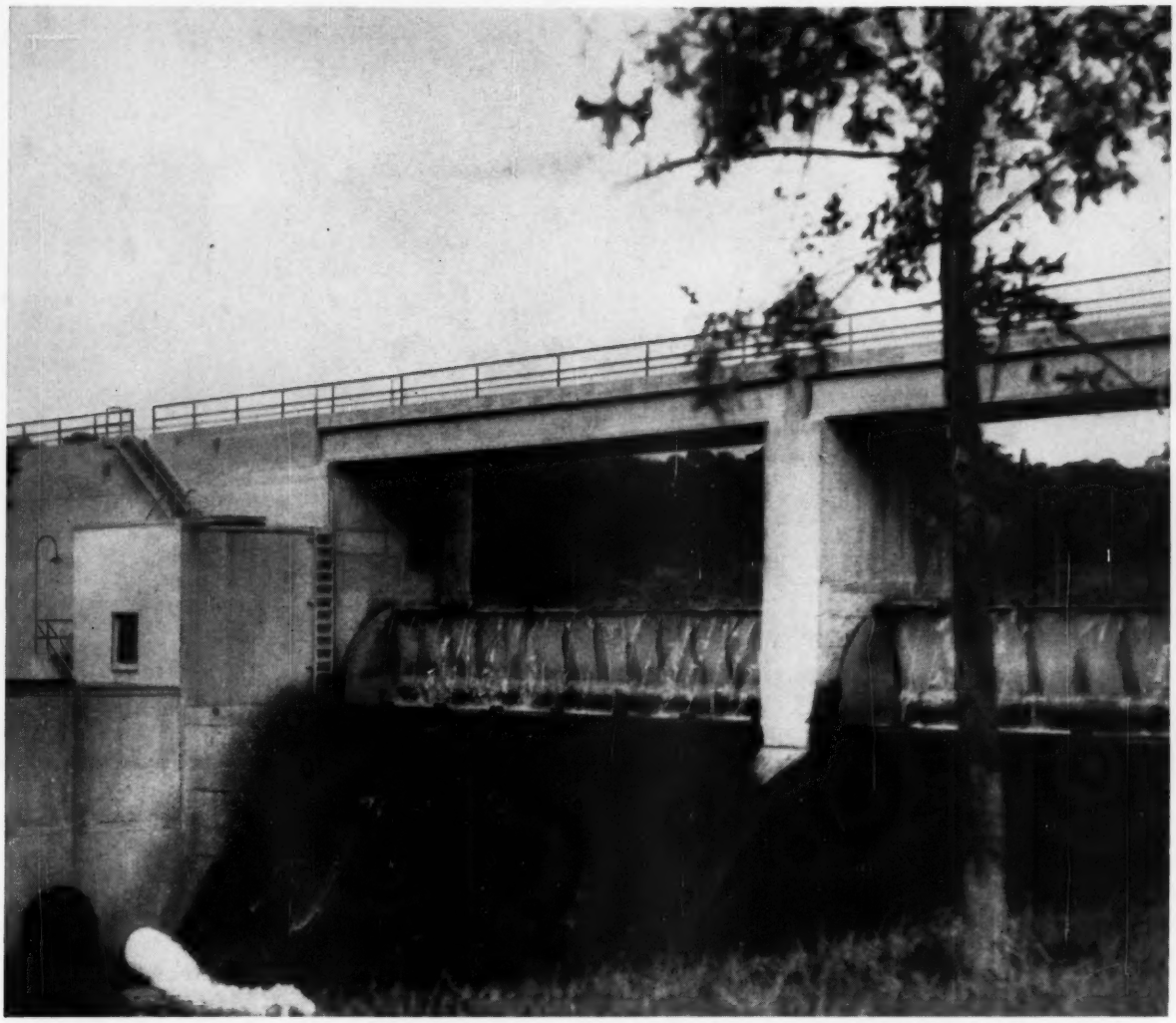

The two Bascule gates at the Lake deForest Dam, Spring Valley Waterworks & Supply Co., N. Y., each 50 feet long by 5 feet high. A-C also provided 24- and 12-inch **Howell-Bunger** free-discharge valves, installed in the left-hand abutment, to regulate minimum flow requirements.

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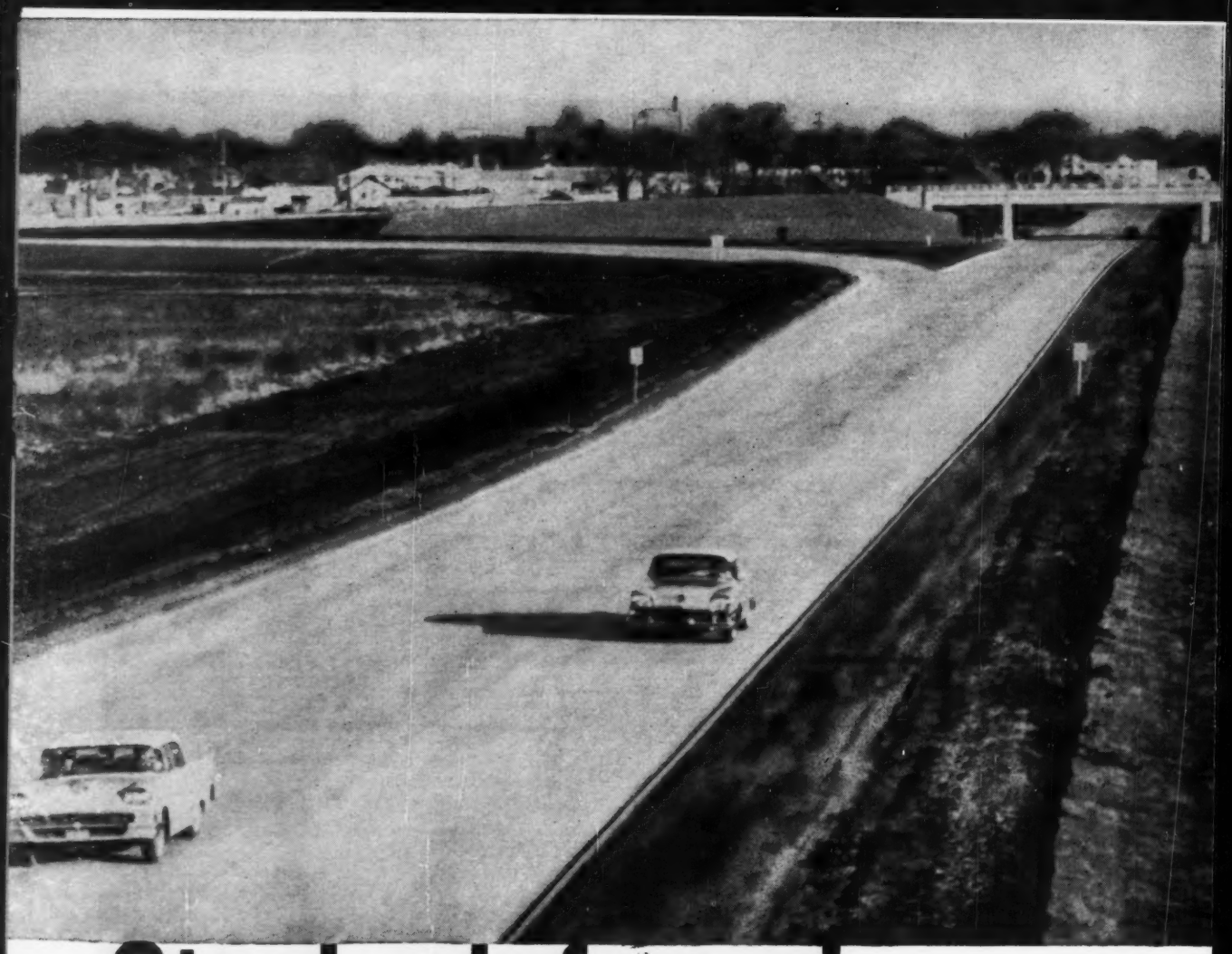

Steel reinforced ...to stand up

PROJECT: Portion of Northwest Expressway just west of Cumberland Avenue Interchange, Cook County, Illinois

OWNER: Cook County Department of Highways

CONTRACTORS: Arcole Midwest Corp., Evanston, Illinois

WIRE FABRIC DISTRIBUTOR: E. W. Zimmerman, Inc., Chicago, Illinois

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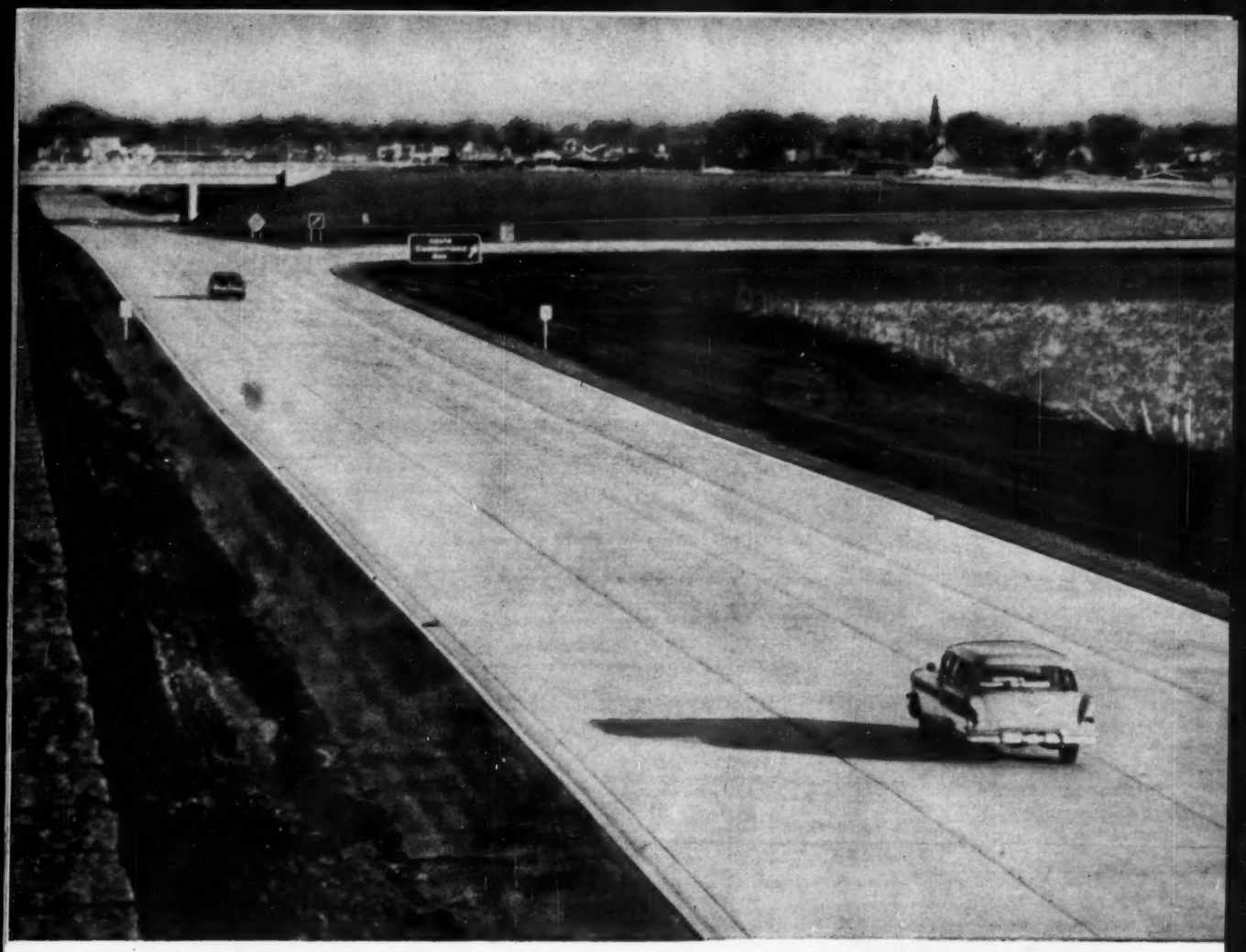

under the hi-speed pounding of modern traffic

Cook County, Illinois has opened the first section of its new Northwest Expressway. And, like other expressways built under the authority and supervision of that county's Department of Highways, it is steel reinforced.

An anticipated daily count of 31,000 vehicles is expected on this newly opened 4½-mile section which extends from Foster & Central Avenues to the Illinois Toll Highway. This figure indicates what this already busy strip will be subjected to as the traffic load gets heavier. And it points up the importance of building into all new roads and highways the strength it will take to stand up under the almost ceaseless pounding of modern hi-speed traffic in the years ahead.

Highways reinforced with steel have a balanced design in that all edges and corners are fully protected. USS American Welded Wire Fabric accomplishes distributed load transfer and reduces stresses about 30% which accounts for the truly superior performance of reinforced concrete over non-reinforced concrete. Reinforced pavements provide a safe, smooth riding surface that lasts.

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3. INNER CIRCLES PIPE allows passing of pipe through pipe underground without requiring excavations or disruption of surface traffic. Permits faster work at less cost in any weather.

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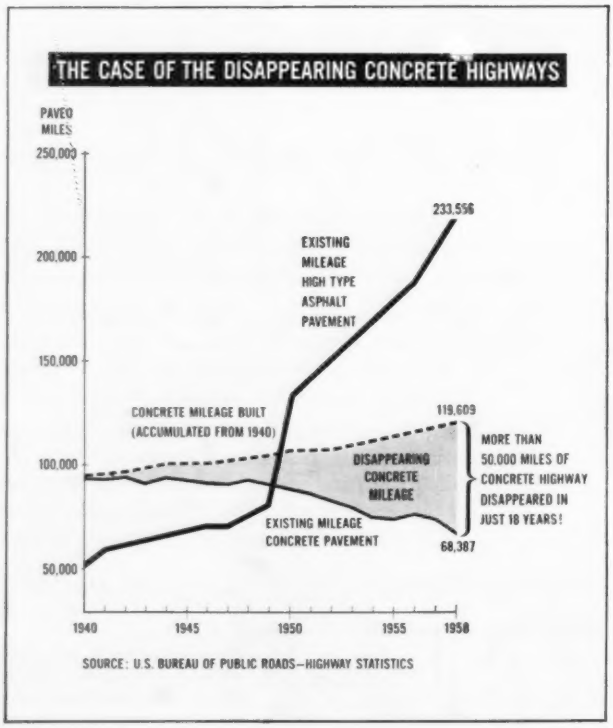

Thousands of miles of expensive concrete roads have disappeared from view in the last 18 years. Most of these roads have had to be covered over with Asphalt paving to restore a satisfactory level of riding safety and comfort. How much better it would have been to use total Asphalt construction in the first place! Many millions in tax dollars would have been saved due to the more economical construction and lower maintenance costs of Deep Strength Asphalt pavements.

Concrete surfaced highways are actually disappearing from the records of the U.S. Bureau of Public Roads faster than they're being built. As this graph shows, from 1940 to 1958, despite the fact that more than 30,000 new miles of concrete roads were con-

EXPLANATION: Figures represent total mileages of high type Asphalt and concrete pavements built by State Highway Departments on state primary systems; municipal extensions to state primary systems and secondary and local roads built by State Highway Departments. See U.S. Bureau of Public Roads HIGHWAY STATISTICS—SUMMARY TO 1955 —table SMB-201 and tables SMB-2, 1956 to 1958 inclusive.

CONCRETE Highways!

structed, *total* concrete mileage *decreased* by over 50,000 miles. This is a decline in concrete mileage 9,000 miles greater than the entire new Interstate Highway System now being built.

During the same period, according to the Bureau of Public Roads records, high type Asphalt-paved mileage increased over 180 thousand miles. And today, over 90% of America's paved roads are Asphalt-surfaced.

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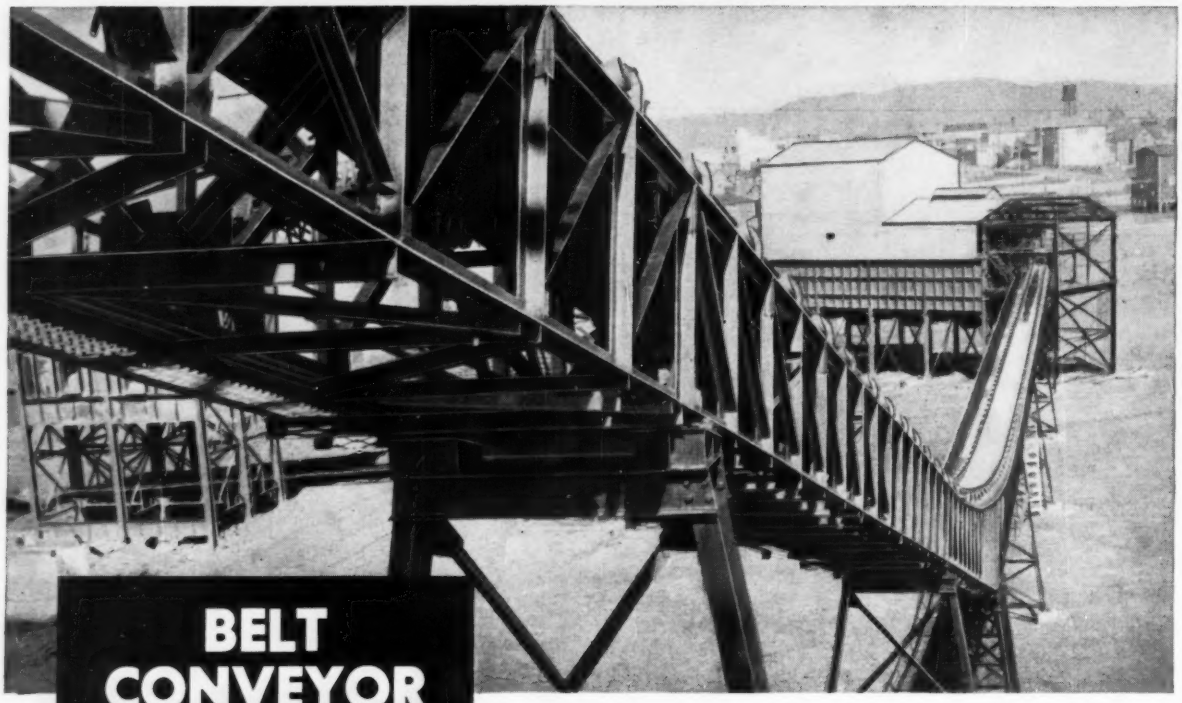

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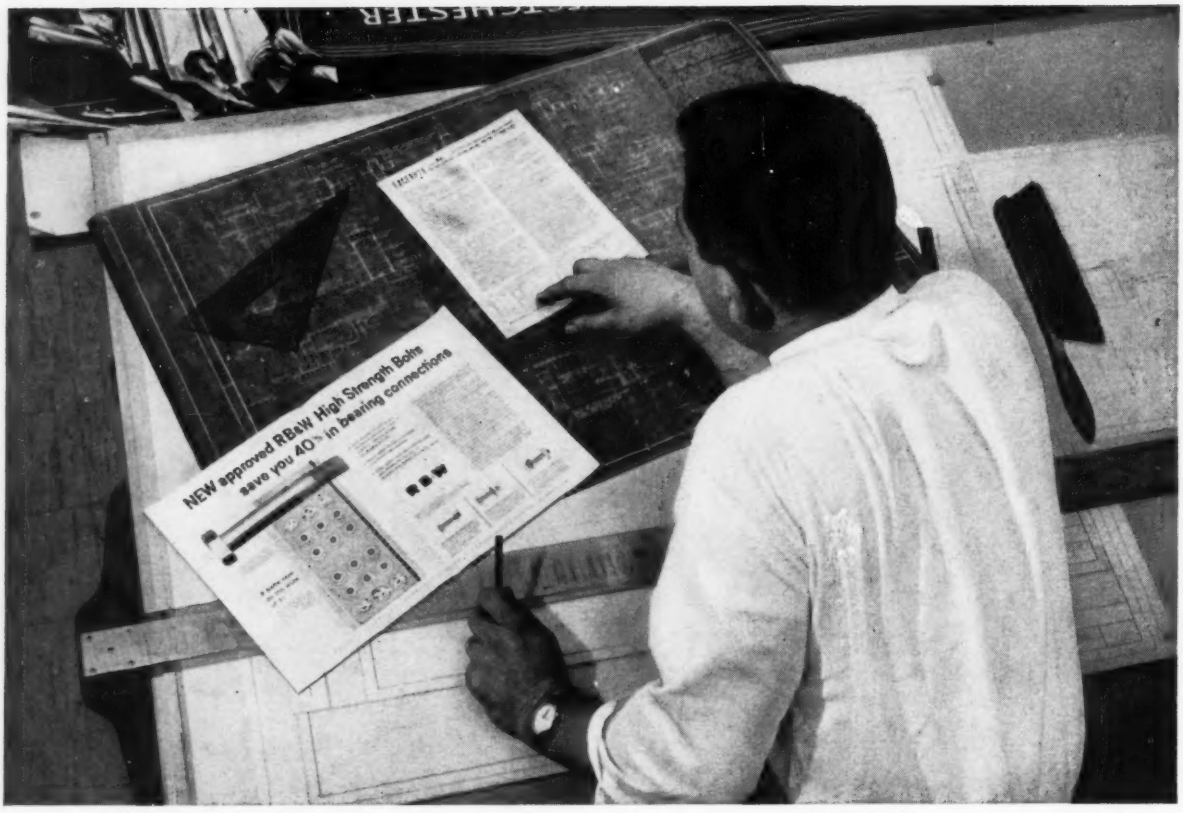
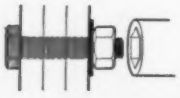


Structural engineers see new way to reduce cost of steelwork

An important change in the specification for structural joints permits a designer to work out economies in shop assembly and field erection costs right at his board.

No longer does the specification consider high strength bolts and rivets equal, except in friction-type joints. In the predominant bearing-type joints, the tensile/shear ratio is changed to take advantage of the new large-head short-thread bolts. Two of these do the job of three rivets; or replace three of the regular high strength bolts. Their short thread length excludes shear planes from passing through a threaded section. Thus, the full shank section is available to develop specified shear strength.



Moreover, only *one* hardened washer is used . . . under head or nut, whichever is torqued in tightening. Obviously, by eliminating one-third the holes, one-third the bolts or rivets, and one-half the washers, shop fabricators can save up to 40% on connections. Field erectors can realize savings similar to these.

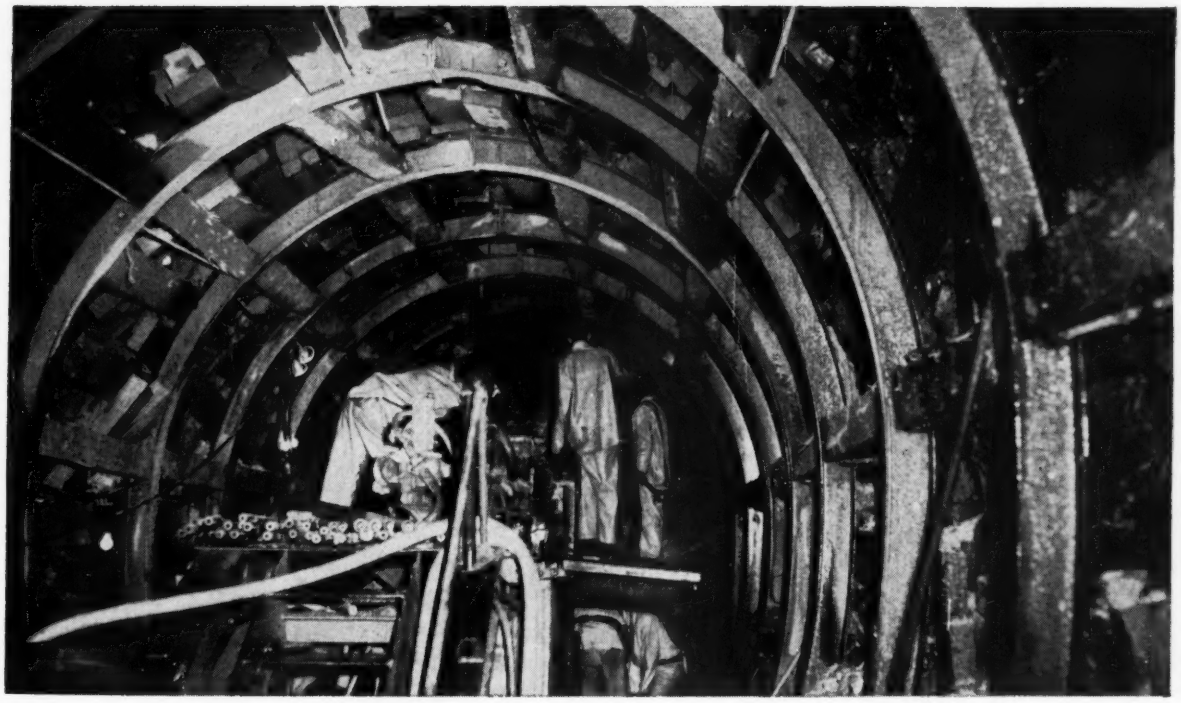
But these savings won't be completely realized, and reflected in lower costs, until *the designer puts this new fastening improvement to work.*

So, if you're a structural engineer, plan now on the economies in the new RB&W High Strength Bolt. And if you're a fabricator or field erector, count on a full size range of these bolts from RB&W . . . all with traditional RB&W quality and certified conformance to ASTM A325 specification. For more data, write Russell, Burdsall & Ward Bolt and Nut Company, Port Chester, N. Y.

RB&W
116th year

Plants at: Port Chester, N. Y.; Coraopolis, Pa.; Rock Falls, Ill.; Los Angeles, Calif. Sales office and warehouse at: San Francisco, Calif. Sales offices at: Ardmore (Phila.), Pa.; Pittsburgh; Detroit; Chicago; Dallas. Sales agents at: Cleveland; Milwaukee; New Orleans; Denver; Fargo.

LARGEST INDEPENDENT PRODUCER OF HIGH STRENGTH BOLTS FOR CONSTRUCTION

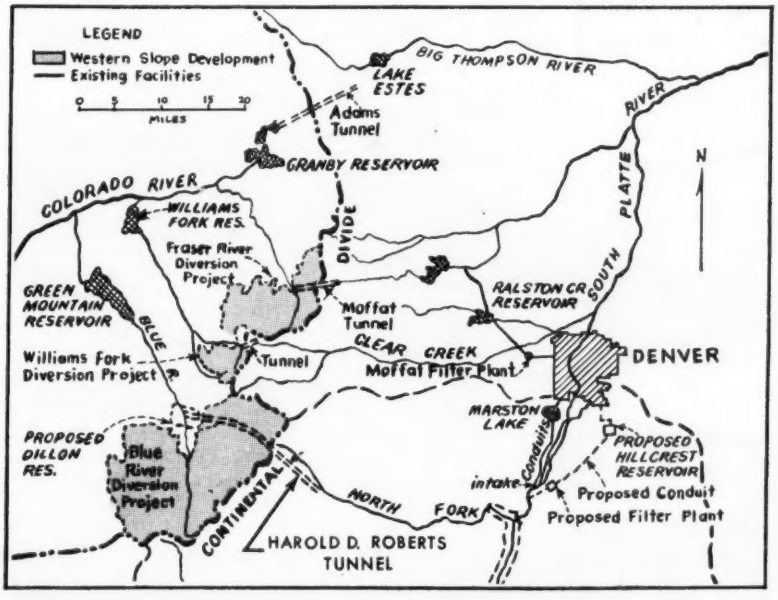


How COMMERCIAL tunnel supports pierce Rockies

As far as water supply is concerned, Denver is on the eastern or wrong side of the Continental Divide. To quench the thirst of Denver's growing population (present water supply will be inadequate by 1970), a $101-million project to tap the Blue River of the water-rich western slope is boring to completion in 1962. An all-important part of this project is the 23 mile long Harold D. Roberts Tunnel.

Tough water problem in tunnel

The first 8½ miles of tunnel lie 600-800 ft. beneath the Snake River through rock faulted with frequent mud slips and high pressure water seams. Here high pressure water, 700 gpm, unchecked by 1500 psi grouting, was encountered and slowed the advance until grout was pumped in four holes drilled 200 ft. into the heading. Bore of tunnel is horseshoe-shaped, 13 ft. 3 in. high and 12 ft. 6 in. wide at springline. In all, 17¼ miles of the tunnel required supports. Standard pattern of support in Pierre shale was COMMERCIAL 6" WF beams @ 20#/ ft., spaced normal on 5 ft. centers. In badly faulted areas of pegmatite, schists, quartzites, gneiss, and coarse-grained, mineralized granite with mud slips and seams, support required spacing down to 2½ ft. centers and 8" WF beams @ 31#/ ft.



8000 square mile, man-made watershed serves Denver.

32 years of COMMERCIAL supports

Entire Denver water supply complex, dating back to early pioneers, will be served by four tunnels: Moffat, Adams, Williams, and Roberts. COMMERCIAL steel supports served Moffat Tunnel (1928), Williams Tunnel (1937), Adams Tunnel (1940). For your next project, COMMERCIAL technical service, backed by over 30 years experience, is available to you for on-the-spot engineering help in tough situations. Write to the Commercial Shearing & Stamping Co., Dept. C-5, Youngstown 1, Ohio.

COMMERCIAL
shearing & stamping

"Ah'm trainin' Oncle Rafe to swim under water... he wants to get a closer look at them boltless joints!"

U.S. cast iron PIPE FOR WATER, SEWERAGE AND

another "first" from U.S. Pipe

Again, U.S. Pipe takes the lead . . .

This time with the new USIFLEX® Boltless Flexible Joint Pipe, specifically designed to cut costs, save installation time and labor on costly underwater jobs.

Developed after years of research . . . and exhaustive tests . . . Usiflex pipe takes to water like a duck. Marvelously simple to install. No bolts, nuts, wrenches. Self-sealing gasket and lead lock your only accessories. And Usiflex locks bottle-tight with only moderate thrust. Once locked, it stays locked . . . cannot be dislodged when assembled or deflected.

Want the full story on the simplicity, dependability, ease of assembly and economy of Usiflex pipe? Call or write for illustrated technical brochure. Today!

U.S. PIPE AND FOUNDRY COMPANY
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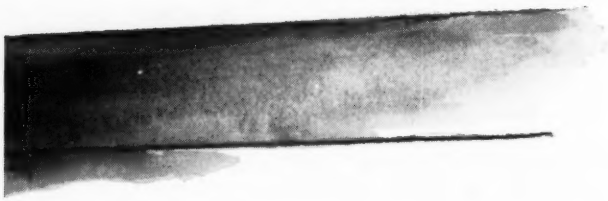
A Wholly Integrated Producer from Mines and Blast Furnaces to Finished Pipe.

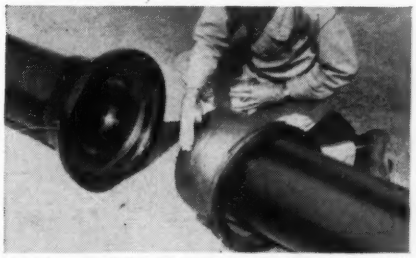


USIFLEX®
BOLTLESS FLEXIBLE JOINT* PIPE

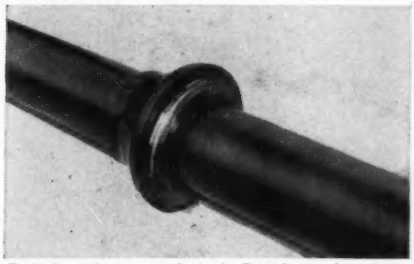
*U. S. Patent No. 2,564,938

INDUSTRIAL SERVICE CAST IRON®

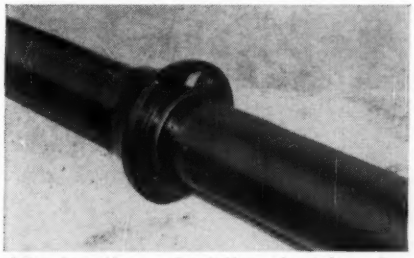
1 Insert the gasket in its seat in the socket. Forming gasket loop helps initial stage of seating. Release of loop allows gasket to spring into the gasket seat where it is securely held.



2 Apply special Usiflex lubricant to the ball and inside surface of seated gasket in socket. After lubrication, ball is ready to be pushed into socket.



3 Ball has been socketed. Retainer ring lugs have been lined up with recesses in bell and retainer ring is ready to be moved into the bell and rotated.



4 After insertion and rotation of retainer ring in bell, the lugs on retainer ring are in back of and in register with internal flange segments in bell. Lead lock is partially inserted into recess between the bell and retainer ring.

5 Lead lock completely inserted in recess is being caulked in place by hammer blows on a wide caulking iron.

In $27-million project, trucks pounded test pavements night and day for two years

1.1 million load applications in the official

Sponsored by the American Association of State Highway Officials (AASHO), this great test will influence pavement design for years to come.

Never has there been a pavement study of such scope. On November 30th, near Ottawa, Illinois, the last trucks made their final runs—to complete the most exhaustive "in-use" testing that pavements have ever undergone.

There were 5 test traffic loops. Each provided a range of representative concrete and asphalt pavement sections. These were pounded over and over by trucks of specified weight rolling at a steady 35 mph. At the end of two years of traffic, every surviving section had absorbed the impact of 1,100,000 loads!

Some 5,000 precision gages and measuring devices were installed in the test pavements. Special instruments were designed to measure changes in surface condition. Readings by the millions were recorded and processed through electronic computers. The thoroughness of the research reflects the scientific direction of the AASHO staff and the Highway Research Board of the National Academy of Sciences—National Research Council.

National Road Test findings will help solve today's problems in highway design and construction. These findings will assist engineers, officials and legislators in providing efficient, economical roads and streets in the years to come.

PORTLAND CEMENT ASSOCIATION *A national organization to improve and extend the uses of concrete*

pound test pavements National Road Test!

The fleet of trucks—from pickups to 54-ton semi-trailers—logged 17 million miles in circling five test loops.

Most significant pavement test of all time!

The National Road Test is sponsored by the American Association of State Highway Officials.

Represented on the National Advisory Committee: American Association of State Highway Officials, American Automobile Association, American Trucking Associations, Inc., Asphalt Institute, Automobile Manufacturers Association, Automotive Safety Foundation, Bureau of Public Roads, Department of the Army, Highway Research Board, National Highway Users Conference, Portland Cement Association, Truck Trailer Manufacturers Association; petroleum industry; state highway departments; tire industry; universities.

Administered and directed by the Highway Research Board of the National Academy of Sciences—National Research Council.

Operated by a staff of engineering and technical specialists.

NEWS OF MEMBERS

Don Johnstone, with the Atomic Energy Commission in New Mexico for the past eleven years, has been appointed to the newly established position of deputy assistant manager for manufacturing in the Commission's Albuquerque Operations office. His past positions were as director of the Nuclear and Explosives Division (1956-1958); as director of the Development Planning Division (1954-1956); as assistant director for Planning (1951-1954); and most recently as director of the Plans and Analysis Division. Mr. Johnstone has been active in ASCE work and is a one-time editor of CIVIL ENGINEERING.

Stephen D. Bechtel, Jr., named executive vice president of Bechtel Corporation in 1957 and chairman of the executive committee in 1959, has now been elected president of the corporation, with headquarters in San Francisco. At the same time his father, **Stephen D. Bechtel,** current chairman of Bechtel Corporation, has been elected to the board of trustees of the Ford Foundation. The senior Mr. Bechtel has served on the President's Advisory Committee on a National Highway Program and as chairman of the Business Advisory Council for the Department of Commerce in 1958-1959.

Arthur G. Hayden was unanimously elected a Fellow by the New York Academy of Sciences at its December meeting. The honor which is restricted to only a few members was awarded to Dr. Hayden for his design and construction of the rigid frame bridge, characterized in the 1953 Centennial issue of Transactions as the "first entirely new form of structure introduced in America in centuries."

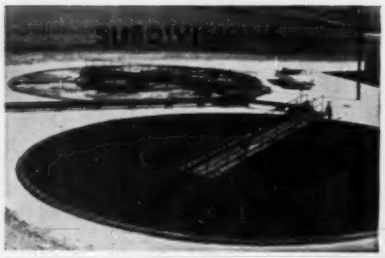
Ford Bartlett, president of Lockwood, Kessler & Bartlett, Inc., civil engineers of Syosset, N.Y., has pooled his firm's resources with those of Raymond & May Associates, planning consultants of Pleasantville, N.Y., to offer a new comprehensive urban modernization service to communities. Lockwood, Kessler & Bartlett, which has pioneered in photogrammetry, is currently engaged in design and supervision of construction of many important metropolitan area projects.

Ellis L. Armstrong, commissioner of the U.S. Bureau of Public Roads, has been named president of the newly organized, non-profit, Better Highways Information Foundation, Washington, D.C. Mr. Armstrong will direct a program of public information on the need for and the benefits of better highways. Prior to becoming Commissioner of Public Roads in 1958, Mr. Armstrong was director of highways for Utah. His previous career included 18 years of engineering and administrative experience with the U.S. Bureau of Reclamation and work on the St. Lawrence Power Project.

Frederick R. Knoop, Jr., is now an associate in the engineering firm of Whitman, Requardt and Associates in Baltimore, Md. Last year he rejoined the firm as project engineer after several years as vice president of Charles R. Scrivener Company, Inc. He was previously employed by Whitman, Requardt and Associates from 1946 to 1954.

WALKER PROCESS **SPARJAIR** COMPLETE SEWAGE TREATMENT PLANTS

Designs for all Developments and Land Planning Projects



Hampton Pk. (Hsg. Devel.), Ill.—1 mgd tot. cap.

Finn Trailer Ct., Ill. (365 units)—45,500 gpd.

Hillcrest Shpg. Ctr., Joliet, Ill.—50,000 gpd.

Sparjair units overcome previous objections to locating a plant near residences, shopping areas, schools, etc. Its new but proven principle of Contact Stabilization aerates and thoroughly oxidizes all odor producing wastes.

Nested design provides complete treatment equal to large municipal plants.

1. Permits development of outlying, low cost land.
2. Capacities from 50 to 5000 population equivalent.
3. Eliminates septic tanks and drain fields.
4. Virtually automatic—Simple operation.
5. Approved by Health Authorities.
6. Odor free — no septic or stale operations.

Details and layouts are available to Consulting Engineers and their Architects, concerned with the design of package sewage and water treatment plants. Write factory at P. O. Box 266, Aurora, Ill. for complete information.

Walker Process also offers CLARIPURE Package Water Purification Plants—pre-designed capacities from 50 to 600 gpm.

WALKER PROCESS EQUIPMENT INC. FACTORY • ENGINEERING OFFICES LABORATORIES AURORA, ILLINOIS

Richard W. Bletzacker, supervisor of building research at Ohio State University's Engineering Experiment Station, has been appointed membership secretary of the American Society for Testing Materials' Committee E-6, Methods of Testing Building Constructions.

James O. Ogletree, currently junior civil engineer with the Humble Oil and Refining Company, has been promoted to assistant civil engineer in Humble's Technical Division at the Baytown, Tex., refinery. Last year, Mr. Ogletree graduated with honors in civil engineering from Mississippi State University.

Jimmie Lee Martin, an engineer at the Esso Standard Oil Company plant at Baton Rouge, La., and a Lieutenant (j.g.) in the Naval Reserve, will participate in the public lecture program and in recruiting activities for the Baton Rouge Reserve Training Center as the commandant's local representative. During his active duty tour in the Navy he served as a district public works officer in the Sixth Naval District at Charleston, S.C.

Harry B. Beard, Jr., until now assistant project engineer for the firm of Whitman, Requardt and Associates, Baltimore, Md., has been appointed project engineer. Since graduation from Johns Hopkins University in 1948, Mr. Beard has been specializing in highway and airport design. In his new capacity he will direct the design of airport and highway facilities.

Charles Y. Hitchcock, Jr., Albert B. Rich, Morton Solomon and **Ariel A. Thomas,** were recently named senior associates in the Boston architect-engineer firm of Metcalf and Eddy. Mr. Hitchcock, who has been with the firm since 1946, is currently project engineer, while Mr. Rich a staff-member since 1954, is chief structural engineer and Mr. Solomon, with the firm since 1958, is project manager. Mr. Thomas has been with Metcalf and Eddy for six years.

T. B. Larkin, Lieutenant General, U.S. Army (retired), after seven years on special duty with the U.S. delegation to NATO in Paris, is currently in Buenos Aires as head of a group of experts making a comprehensive transportation study of Argentina for the World Bank and the Argentine government.

Arthur J. McNeil retired recently at the age of 80 after many years as engineer-inspector of new buildings for the Sacramento (Calif.) City Unified School District. Earlier, he was resident engineer of construction with Associated of California and other oil corporations.

Rodney R. Fleming has resigned as city engineer for Sioux City, Iowa, to become associate editor of *American City*, with headquarters in New York. As city engineer of Sioux City, he directed the design of a $3,000,000 interceptor sewer system and $2,400,000 paving program.

WHEN HE GOES UP...YOUR COSTS GO DOWN!

This man builds fast, and he builds to last. He works with steel...the proven material for strength, endurance, and adaptability. He works for Ingalls...the proven source for skill, versatility, and economy in steel fabrication and erection. Steel and Ingalls...together they make a great team. Why not get them on your side on your next construction job?

The Ingalls Iron Works Company / Birmingham, Alabama

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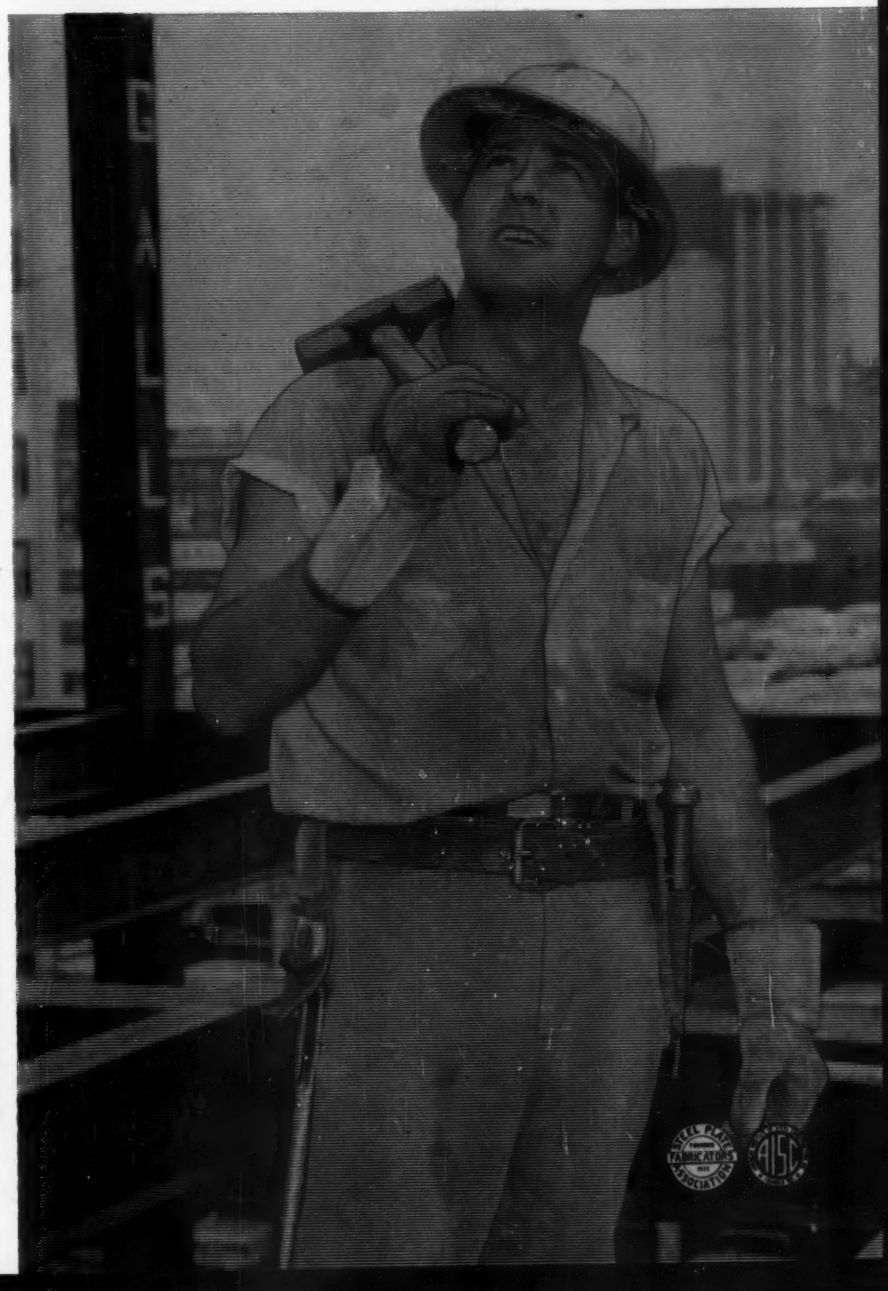
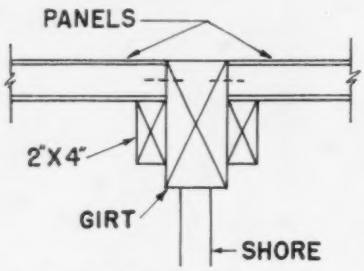


Slab Forming

Symons Steel-Ply Forms Used Twice Per Month

. . . Material Costs Reduced to 10 Cents a Square Foot

Slab forms were stripped in 10 days without disturbing the support shoring; still met specifications calling for 28 days of slab support.



2 x 4's bolted to girt are removed, for ease of stripping.

When constructing apartments on the campus of Stanford University, Howard J. White, Inc. had one big problem . . . how to reduce slab-forming costs. Symons Steel-Ply Forms were the answer.

4 x 6 girts, laid longitudinally with the floor slab, are first set in place on shores and flush with the bottom of the slab. When the slab is poured, it bears directly on the timber girt. Next, 2 x 4's are bolted to the girt to form a ledge. Symons 4 ft. Steel-Ply Panels are dropped in place on the 2 x 4 ledge. No connecting hardware is used . . . carpenters drive a nail through a form-hardware opening to the girt on each panel so that when the 2 x 4 ledges are removed, the panels will not fall.

For the complete story on *slab forming*, just send in your request. Symons Steel-Ply Forms are rented with purchase option.

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Warehouses Thruout the U.S.A.

MORE **SAVINGS** FROM **SYMONS**

Neil Welden, with the Iowa State Highway Commission since 1933, retired last month from his position as bridge engineer, a post he has held for the past six years. Mr. Welden, however, plans to continue designing bridges. **Charles Pestotnik,** at the present time chief assistant in detail bridge design, is scheduled to succeed him.

John D. Hess is establishing a major physical testing laboratory to serve the entire State of Arizona. The new operations, part of the John D. Hess Testing Corporation, will be confined to materials engineering, engineering geology and applied soil mechanics. Since 1953 the organization has offered complete physical and chemical testing services in the Yuma and Western Arizona areas.

Laurie M. Leedom, veteran Newark, N.J., city employee was recently appointed engineer in charge of the Division of Water Supply. For more than 30 years, Mr. Leedom has been on the city's engineering staff, most recently as assistant division engineer.

Edmund C. Garthe, who recently retired from the U. S. Public Health Service, has been named assistant director of the Kentucky State Department of Health's Bureau of Environmental Health. He joined the Public Health Service in 1936, and had been regional engineer in its Washington, D.C., Chicago, New York City and, most recently, Denver, Colo., offices.

Russell L. Culp, on January 1, joined other water engineering specialist currently employed by Cornell, Howland, Hayes & Merryfield in the firm's Corvallis office. For the past ten years he has been chief of the Kansas Water Supply Section of the Kansas State Board of Health, and prior to that was employed by Paulette and Wilson and Black & Veatch.

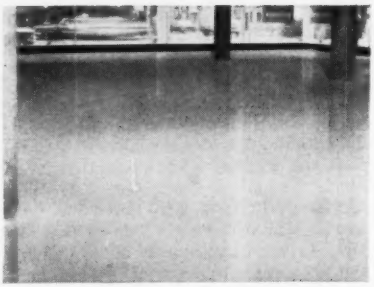
Albert F. Raulin, until recently associated with Floyd G. Browne and Associates of Marion, Ohio, has opened his own engineering office at 128 South State Street, Marion.

Dwight H. Bray, chief engineer of the Kentucky Department of Highways since 1948, has been elected president of the American Association of State Highway Officials. Mr. Bray served as president of the Kentucky Section in 1940, and is a past-president of the Southeastern Association of State Highway Officials and the Mississippi Valley Conference of State Highway Departments.

TRETOL DEKOTE CONCRETE FLOOR TREATMENT

1 APPLICATION:

CURES
HARDENS
SEALS
DUSTPROOFS



Apply DEKOTE to freshly troweled concrete floors by spraying, brushing, or by roller, and you get a floor that looks better, is stronger, will last longer and be easier to maintain.

DEKOTE, as a curing agent, retains 95% of the moisture in concrete to assure positive, complete hydration for maximum strength and hardness. It effectively seals concrete surfaces against most acids, oils, greases, and other foreign materials. Objectionable dusting, usually found in untreated concrete is eliminated.

Paints and tile adhesives may be applied to DEKOTE-treated floors without removing the DEKOTE membrane.

DEKOTE is a clear, fast-drying material that imparts a smooth, natural lustre to concrete that makes it easy to maintain and clean.

For complete information and specifications on this new concrete floor treatment, write for DEKOTE T 130 Catalog Sheet.

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Quality Products for Concrete and Masonry

6051 W. 65th STREET, CHICAGO 38, ILLINOIS

Division of Serviced Products Corp.

Rolf Eliassen, professor of sanitary engineering and head of the division of sanitary engineering at the Massachusetts Institute of Technology, has been made acting head of the Department of Civil and Sanitary Engineering there. **John B. Wilbur,** who has been head of the department since 1944, has been appointed consulting professor of engineering at his own request. Dr. Wilbur became a faculty member in 1930, acting head of the department in 1944, and head in 1946. Dr. Eliassen, a member of MIT's faculty since 1949 and 1950 winner of the American Society for Engineering Education's George Westinghouse Award, was in Vienna last year to set up a 72-nation research program on the disposal of radioactive wastes for the International Atomic Energy Agency.

Charles M. Dent, Jr., former senior design engineer with the American Enka Corporation, Enka, N.C., recently joined the Redevelopment Commission of the City of Asheville, N.C., as executive director. Mr. Dent has been employed by American Enka for the past nine years.

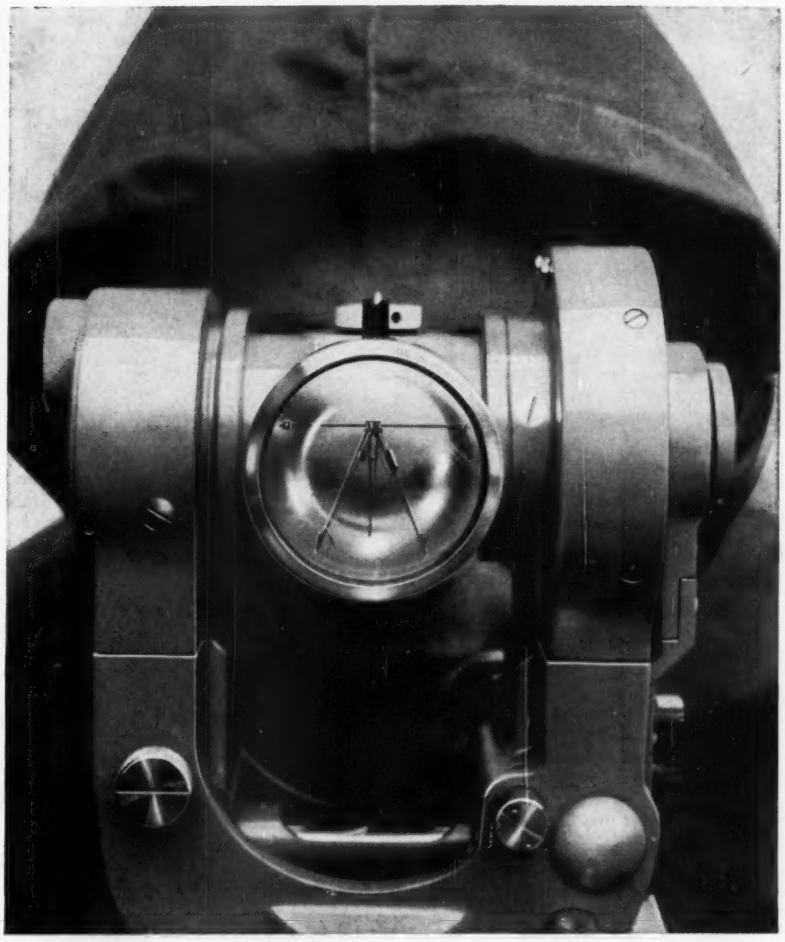
Merle H. Banta has been elected a George F. Baker Scholar, the highest scholastic honor at the Harvard Graduate School of Business Administration. Mr. Banta entered the Business School after completing four years of service with the Civil Engineer Corps of the U.S. Navy and will graduate in June 1961. He was 1955 winner of the Daniel W. Mead Prize for Associate Members.

T. J. Montgomery, a veteran of 29 years' service with the City of Cincinnati, including ten years as city engineer, has been appointed executive secretary of the Pinellas County (Florida) Paving Contractors Association. His work in Cincinnati included the posts of principal engineer in charge of construction (five years); assistant superintendent of the highway maintenance division (seven years); and assistant superintendent and superintendent of Cincinnati General Hospital (seven years).

Lawrence F. Keane, Jr., has resigned from Albright & Friel, Inc., of Philadelphia, to join the eastern sanitary sales division of Dorr-Oliver Incorporated, in Stamford, Conn., as a sales engineer. In his new position, Mr. Keane will be responsible for the firm's sales and engineering services to water, sewage and industrial waste treatment projects in New Jersey.

Purd B. Wright, who has been with the Ash Grove Lime and Portland Cement Company, of Kansas City, Mo., since 1946, has been elected president of the organization. Mr. Wright entered the cement industry in 1935, after earlier professional work.

(Continued on page 26)



THE UNIVERSAL STANDARD for accuracy, ruggedness and speed of operation. With readings direct to one second, the instrument is ideal for triangulation and laboratory use. AVAILABLE WITH A COMPLETE RANGE OF ACCESSORIES... Invar Subtense Bar, Diagonal Eyepiece Set, Pentagonal Objective Prism, and Autocollimation Eyepiece.

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WILD T-2
UNIVERSAL THEODOLITE
One of a *complete* line of superb instruments for Surveying, Photogrammetry and Microscopy. *Write for Booklet T-2.*

WILD HEERBRUGG INSTRUMENTS, INC. • PORT WASHINGTON, NEW YORK
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R. C. Hammersmith, until recently assistant manager for construction in the Industrial Construction Department of Kaiser Engineers, in Oakland, Calif., is now resident manager for Kaiser on the Atomic Energy Commission's new production reactor construction project at Hanford, Wash. During construction of earlier plutonium production reactors at Hanford, Mr. Hammersmith was chief construction engineer for Kaiser Engineers. He was also chief engineer on Kaiser's hydroelectric construction work for the Snowy Mountains Hydro-Electric Authority in Australia.

J. D. Strong, Colonel (retired), Army Corps of Engineers, is now field representative of the National Society of Professional Engineers. Colonel Strong, the originator of the Army's professional engineer preparatory course for qualified personnel of the Armed Services who desire to obtain registration, retired from the Corps last year.

Frederick G. Nelson, who recently retired from Dorr-Oliver, Inc., after serving 32 years in various capacities ranging from sanitary engineer to director of the sanitary technical division, is now assistant to the president in the Los Angeles consulting firm of Koebig and Koebig. For the past year as manufacturing representative of Dorr-Oliver he has been consultant to the Sanki Engineering Company in Japan.

Mons H. Benson, after 30 years of government service, has retired as head of the design section of the U.S. Bureau of Reclamation in Boise, Idaho. Part of the time he was a civilian employee with the Army Corps of Engineers. Currently, he is with Morrison-Knudsen's International Engineering Company in charge of the design directorate of the East Pakistan Water and Power Development Authority.

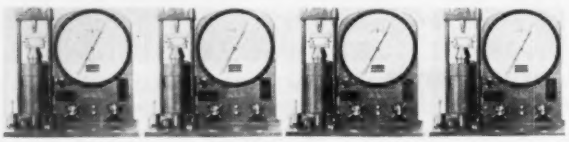
Robert G. Dean, a recent Ph.D. graduate and staff member at the Massachusetts Institute of Technology, has accepted a position as research engineer in Producing Technology at the La Habra Laboratory of the California Research Corporation, a Standard Oil Company of California subsidiary.

Thomas B. Redmond, Jr., in his new capacity as autoclave engineer with the National Concrete Masonry Association of Washington, D.C., will be responsible for research and testing activities involving high pressure curing of concrete masonry. He was formerly employed for three years as an engineer in the hydraulics laboratory and machinery design division of the Newport News (Va.) Shipbuilding and Dry Dock Company.

Raymond Vreatt recently retired as plant manager of the American Bridge Division of the U.S. Steel Corporation, at Elmira, N. Y. Following graduation from the Clarkson College of Technology in 1926, Mr. Vreatt started work as a draftsman in the engineering departemtn of U.S. Steel. Since that time, he has served as assistant to the manager (1946), plant superintendent (1951), and plant manager (1954).

Claude A. J. English, after 28 years' service with the Federal government, is retiring as planning engineer for the Sacramento District of the Corps of Engineers. Since 1942 he has been assigned to the Sacramento district, planning for the construction of the Sacramento Signal Depot, veterans' administration hospitals in Fresno and Salt Lake City, and Beale Air Force Base Hospital near Marysville.

Robert S. Holmes, promoted a year ago to the position of assistant manager of highway construction marketing for the U.S. Steel Corporation, Pittsburgh, Pa., has now been named manager. In his new post he will coordinate the efforts and interests of U.S. Steel and its various divisions in support of the Federal highway program.



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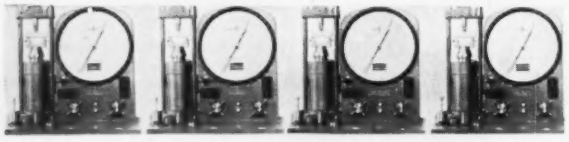

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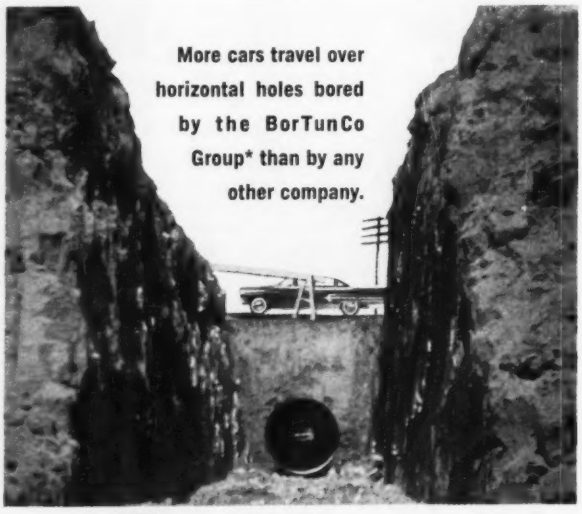

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William H. Hawes, for the past three years district engineer for the American Institute of Steel Construction in Minneapolis, has joined the firm of Andersen and Koerwitz, which will continue its structural engineering practice under the name of Andersen, Koerwitz and Hawes, at 655 Broadway, Denver, Colo. The firm has done the structural design for a number of Denver and Boulder, Colo., projects.

John R. Snell, who founded Michigan Associates in 1956, announces that the firm's name will be changed to John R. Snell Engineers, Inc. As president of the reorganized company, Mr. Snell will direct the firm's continuing services in municipal and industrial engineering, both in the United States and abroad.

Herbert J. King, well-known throughout the construction industry, has ended a 56-year engineering career. His outstanding projects include the eight-mile-long Great Northern Railroad's Cascade tunnel in Washington and tunnels in Southern California for the Los Angeles Metropolitan Water District. For the past nine years he has had responsibility for the negotiations section in the Construction Division of the Army Corps of Engineers in the San Francisco District.

Gonzalo de Navacerrada, until recently engineer in charge of the first zone of the province of Lerida, Spain, has assumed new duties as project director of an experimental road section being constructed in Madrid, the first full-scale road test in that country.

E. H. Schmidtman has been promoted from assistant vice president to vice president of the Wisconsin Electric Power Company, Milwaukee. In addition to his new obligations, Mr. Schmidtman will retain his present duties. He is a past president of the Wisconsin Section.

Boris S. Kalinovsky has joined Cooper & Clark, soil and foundation engineers of Palo Alta, Calif., as a consultant. For the past 18 years, Mr. Kalinovsky has been employed in the San Francisco office of Dames & Moore. As a project engineer for the firm, Mr. Kalinovsky directed a wide variety of large and involved foundation investigations in the United States and overseas.

Lewis W. Hixson, partner in Hixson-Tarter and Associates of Cincinnati, Ohio, has reorganized the firm to include the services of a registered architect under the firm name of Hixson, Tarter and Findlay. Mr. Hixson's wide experience in the construction industry, particularly in applications of reinforced concrete, includes work with the Tennessee Valley Authority and the Navy Civil Engineer Corps. He is also an associate professor at the University of Cincinnati.

The Clay Pipe Industry's research has pioneered dramatic new developments, making production and installation of lifetime Vitrified Clay Pipe more efficient and effective.

For example, Clay Pipe Industry research discovered the revolutionary resilient compression joints which are now offering important savings in installation time and cost to users of lifetime Vitrified Clay Pipe sanitary sewers.

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One experiment that promises to have far-reaching effects: detailed, year-long observations of root penetration of 16 separate sewer pipe joints. Others include shear load studies of both pipe material and joints, development of new, less expensive jointing materials and techniques, exhaustive analyses of competitive products, flow-coefficient studies, and various tests aimed at improving the clay pipe itself.

Results of the most significant of these tests will be announced as they become available.

Under the direction of A. J. Reed, NCPMI Vice President and Director of Research, new breakthroughs in manufacturing and uses of Clay Pipe are being made, offering greater, more confident service to those who specify and use lifetime Vitrified Clay Pipe.

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An all purpose, highly accurate surveying instrument that has become the criterion against which measuring unknown distances by other means are compared.

The Geodimeter system employs a unique principle of light that functions perfectly at night and now even in daylight. Requires only one trained operator and one assistant to operate and conduct the entire survey. Results? Absolutely superior to any means previously devised.

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. . . . . *Am-Soc Briefs*

▶ ▶ Contributions to the UEC fund are still coming in. . . . Though ASCE completed its fund-raising obligations for the United Engineering Center months ago, a number of Sections have continued an informal campaign to meet their quotas. The year-end campaign picture -- by Section, District, and Zone -- appears on page 73. . . . Other groups over the top are the American Institute of Chemical Engineers, the American Institute of Consulting Engineers, and the American Institute of Industrial Engineers. . . . Nearing their goals are the Electricals, with 95 percent of their allotted $900,000 in hand, and the Mechanicals with 91 percent collected.

▶ ▶ New ASCE Salary Index. . . . The Society's biennial Salary Index changes this month to provide figures as of January 31. It will be noted that the trend in pay rates for civil engineers is up in seven of fifteen U.S. cities. The report is based on analyses of data provided semi-annually by a picked group of respondents. Trends in major cities are supplied by leading consulting firms. Regional figures are based on reports from state highway departments. See page 72 for the new Salary Index.

▶ ▶ All persons holding positions in public service whose duties involve any type of engineering responsibility should be registered professional engineers. . . . This is the essence of a policy statement adopted by the Board in Los Angeles in February 1959. After review of the statement at a recent meeting in New York, the Committee on Engineers in Public Practice voted to request the Executive Secretary to bring this policy to the attention of the new chairman of the Civil Service Commission, with copies also to go to the federal agencies employing engineers.

▶ ▶ More time for Mead Prize contestants. . . . Associate members and students interested in competing in the 1961 Daniel W. Mead Prize Contest have until June 1 as the final date for submitting their essays instead of May 1, as in the past. Other new rules and streamlined procedures are summarized in the January issue (page 72).

▶ ▶ Index to Civil Engineering. . . . Each member rates a copy of the 1960 Index to Civil Engineering. Request should be made by post card to Society headquarters. . . . There is also the Cumulative Index to ASCE Publications, indispensable to those with bound volumes of Civil Engineering, Proceedings, and Transactions. This one is $20, with a 50 percent discount to members and libraries. Coupon for ordering in the January issue (between pages 32 and 33).

▶ ▶ Also for sale. . . . The papers from the Second Conference on Electronic Computation, held in Pittsburgh in September, and a Bibliography on Airport Engineering, published by ASCE and covering the strategic 1938–1959 period. Details and coupons on page 109.

ALPHA

BETTER CONSTRUCTION THROUGH
BETTER USE OF CEMENTS

news and notes from the field

Tips On Building Watertight Concrete Structures

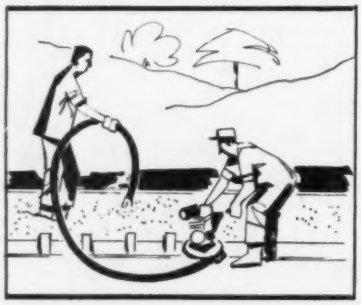
The increasing use of concrete for swimming pools, basement playrooms, industrial sub-surface garages and similar structures continues to reflect the growing interest in watertight concrete. Moreover, of the many questions asked Alpha Field Engineers, those about watertight concrete today are one of the most common.

Watertight concrete can be produced without undue difficulty when proper emphasis is placed on good design, good concrete and good workmanship. Extensive testing and careful examination have revealed that the most common reasons for leaky concrete are **inferior workmanship, poor materials and too lean a mix.**

Good Concrete:

Modern ready mix concrete plants today are equipped to furnish concrete of the very highest quality, but the user must specify the mix and make sure the concrete is not ruined on the job by someone insisting on additional water. The most modern mixing plant, the best materials and the best mix design mean nothing when the water content is not controlled and the concrete is improperly placed and cured.

The Right Mix:



Use a quality concrete mix and place it in even layers not more than 18 in. deep. Avoid honeycombing by adequately spading or vibrating each layer.

Experience has indicated that for such structures as tanks and reservoirs the concrete should contain not more than 6 gal. of water per sack of cement. For concrete in very heavy sections such as dams, the water may be increased to 7½ gal., while for thin sections it should be reduced to 5 gal. These amounts include the water which is introduced as surface moisture in the aggregate. Coarse aggregate usually contains little if any moisture, but the sand often contains a considerable amount of water.

Avoid Segregation in Placing Concrete:

Concrete should be delivered at a number of points around the form to avoid chuting over long distances. This prevents segregation, a source of possible leaks.

Of all the steps in watertight concrete work, handling, placing and compacting in the forms are among the most important. Concrete should not be allowed to drop freely more than 5 or 6 feet, as segregation is likely to occur if it falls through a greater distance. Flat chutes should not be used even for short distances. **Chutes should be deep with rounded bottoms, and constructed of or lined with metal.** Buggies should be operated on smooth runways. Buggies equipped with pneumatic tires reduce segregation. Dumping a large quantity of concrete in one place and then causing it to flow horizontally over a long distance in the form is not good practice and should never be done. Concrete should be distributed by placing in uniform layers 1 foot to 18 inches thick, spading or vibrating each layer to consolidate the concrete.

Construction Joints:

One of the frequent sources of difficulty has been at construction joints. Wherever possible, the work should be so planned that placing of concrete will be continuous. In large structures expansion joints are sometimes provided, but placing should be continuous between joints. Where a construction joint must be made, precautions should be taken to secure good bond between the layers. If the structure is to be subjected to water pressure such as in a tank and if a construction joint is to be made between hardened and fresh concrete, a waterstop should be installed.

Curing:

Keeping the concrete wet for at least 7 days when normal portland cement is used, or 3 days if high-early strength portland cement is used, should be required on all watertight construction.

Surface coatings are helpful in overcoming leakage on some structures, but cannot be expected to overcome faulty joints or defective areas. An effective surface treatment is the application of a grout of equal parts portland cement and fine sand mixed to the consistency of paint and applied with brushes. The concrete should be damp when this is applied and the coating should be dampened as soon as the cement has set sufficiently so that it will not be washed off. It should be kept damp at least 24 hours.

Use whitewash-size brush to apply surface coating.

More Information

Your Alpha Field Engineer can answer your questions on watertight concrete construction and help with any other problems involving the use of Alpha cement. Reprints of this advertisement are yours for the asking.

ALPHA
PORTLAND CEMENT COMPANY
Alpha Building, Easton, Pa.

do you know that

One of the world's most ambitious power projects is nearing completion? The $720,000,000 Niagara Power Project, to be dedicated on Feburary 10, harnesses the maximum potential of the American share of the Niagara River. It will provide 2,190,000 kw of power, making it the largest hydroelectric development in the Western World. Grand Coulee Dam, the present leader, has an installed capacity of 1,974,000 kw. Financed by the sale of revenue bonds, the Niagara Project has been built without tax money and without state or federal funds. An article giving construction details of the mammoth project is scheduled for an early issue.

▪ ▪ ▪

Last year $19.3 billion was spent on new highways in the Free World? The 1960 increase over 1959 was 3.75 percent, according to the International Road Federation. Once again the U.S. topped the list for highway expenditures with $11.8 billion. Canada was in second place, with $1.35 billion spent; West Germany third, with expenditures of $1.2 billion; and Japan in fourth place, with a total of $570 million spent. The U.S. has the largest fleet of motor vehicles with 73,868,000 registered and the greatest highway network with 3,500,000 miles of road. Data are from 161 countries all over the world.

▪ ▪ ▪

Long-term leasing of equipment by construction companies gained in 1960? The value of equipment leased during the year was $47.1 million, a gain of 2 percent over 1959. Equipment leased by all industry last year totaled $530 million, topping the half-billion mark for the first time. Robert Sheridan, president of the Nationwide Leasing Company, Chicago, predicts that by 1962 leasing volume will reach $1 billion a year.

▪ ▪ ▪

Soviet driver tests reflect the shortage of highway service facilities? With Russian service stations from 60 to 90 miles apart and offering nothing but gasoline, Soviet drivers must pass rigorous examinations on the construction of engine and car and prove themselves able to make all but major repairs. State-operated garages—offering repair facilities only—are from 125 to 190 miles apart and have no fueling facilities. Authority for this is Dr. F. R. Noffsinger, of the Northwestern University Traffic Institute, quoted in a recent issue of *Oil Facts*.

▪ ▪ ▪

Power plants improve fish life? In a paper presented at the winter annual meeting of the ASME, Melvin D. Engle, chief mechanical engineer for the Pennsylvania Power and Light Company, Allentown, said that fish like the warm water discharged from his company's power plant on the Delaware River. In early spring and late fall, when fish normally are dormant in the cold water, many of them swim up to the plant's discharge canal to warm themselves. A professor conducting tests there caught 100 bass in an hour. This may disprove the old idea that power plants are a menace to river life.

▪ ▪ ▪

Recent college graduates find it easier to get jobs than experienced alumni? This finding is reported by the University of California's Student and Alumni Placement Center at Berkeley, one of the West Coast's largest. While many companies have temporarily stopped hiring experienced personnel, they are stepping up interviews of new college graduates and college seniors, according to Manager Robert Calvert. Cited as one reason is the policy of many firms of keeping a constantly renewed pool of potential managerial and executive talent.

▪ ▪ ▪

The Great Lakes contain the world's largest supply of fresh water? However, a University of Michigan oceanographer warns that this vast supply—6,700,000 billion gallons of it—will not be available to our children's children unless the Lakes can be preserved as a natural resource. It isn't a question of drinking them dry, but of dumping into them so much chemical and organic waste that they will become full of plants and silt and cease to be lakes. To control this aging process is the long-term goal of the university's Great Lakes Research Division.

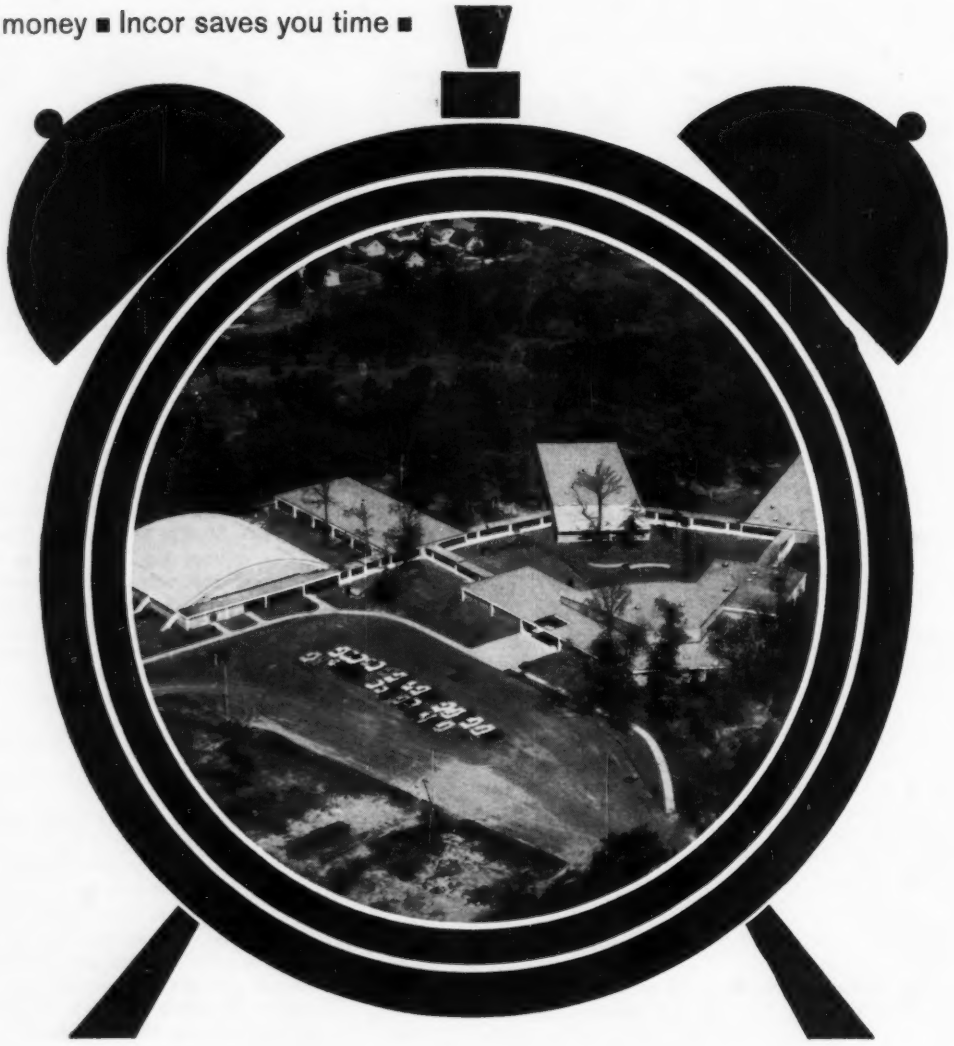
▪ ▪ ▪

U.S. steel shipments during the 1950's were at an all-time high? Domestic markets received over 710 million tons of finished steel products in the decade just passed—the highest ten-year total in history. The largest share (139 million tons) went to warehouses and distributors, followed by the automotive industry (136 million tons) and the construction and contracting industry (128 million tons). Figures are from the American Iron and Steel Institute.

▪ ▪ ▪

Scientific and engineering employment is up? Employment of scientists and engineers in industry rose nearly 7 percent between January 1959 and January 1960, according to the National Science Foundation. This compares to a 5 percent rise between 1958 and 1959. More than 800,000 engineers and scientists were employed by U.S. business firms in January 1960, compared to the 764,000 employed by a similar group of firms in January 1959. Copies of *Scientific Personnel in American Industry* (NSF-60-62) are for sale by the U.S. Superintendent of Documents (Washington 25, D.C.) for 45 cents.

time is money ■ Incor saves you time ■



precast concrete and Incor cut school cost $216,000 below New Jersey average

Exceptional construction economy along with fire-safety, quality, and beauty . . . that's the sharp lesson taught by Iselin (N. J.) Junior High School. Built for Woodbridge (N. J.) Board of Education, this $1,462,000 school opened right on schedule.

Economy was achieved by extensive and imaginative use of precast and prestressed concrete units made with Incor. Incor 24-hour cement gives any job a head start in construction time and cost savings. Here, the cost per pupil of $1,462 compared with the New Jersey average of $1,678, thus saving taxpayers $216,000 on this 1,000-pupil school.

With Incor, jobs get done faster . . . men, forms, and equipment are released quicker. And its durability is proved by 33 years of performance. Estimate with Incor on your next project . . . you'll find it pays.

Iselin N. J. Junior High School—Architect-Engineer: Finne-Lyman-Finne, Elizabeth, N. J. Educational Consultant: Engelhardt, Engelhardt, Leggett & Cornell, New York, N. Y. General Contractor: Michael Riesz Co., Fords, N. J. Prestressed Concrete: Atlantic Prestressed Concrete Co., Subsidiary of The Warner Co., Trenton, N.J.

AMERICA'S FIRST HIGH EARLY STRENGTH CEMENT

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CIVIL ENGINEERING

Detroit's Convention Arena and Cobo Hall

Prepared by the staff of Giffels & Rossetti, Inc.
Architects and Engineers, Detroit, Mich.

Two structures, one rectangular and one circular in shape—designed as a single project—form the westerly terminus of Detroit's 112-million-dollar Civic Center. The ground area covered by the two structures is 17 acres, 12 of which are occupied by the rectangular-shaped Cobo Hall with its 1.6 million sq ft of floor and deck space. The circular Convention Arena adjoins it. In Cobo Hall, the Convention Arena and the Arena garage, there are 51 acres of utilized floor and deck space with unequaled facilities for many activities.

Cobo Hall, extending 900 ft northward from the Detroit River in three levels, contains generous dining and meeting-room facilities overlooking the river, as well as unmatched exhibit space and supporting storage and service areas. The first of the three main floors, at the waterfront street level, includes Hall D with 100,000 sq ft of exhibit space, 90,000 sq ft of exhibitors' storage space, covered truck docks, an around-the-clock restaurant, and service areas.

The second floor, at the upper plaza level at the junction of Jefferson Avenue and Washington Boulevard, contains the main exhibit hall which is 715 ft long and 405 ft wide with a 30-ft ceiling height. On the second floor also are the main banquet hall and four meeting rooms. This uninterrupted level extends from the Detroit River to the north, passing over Hall D, the exhibitors' storage area, the John C. Lodge Expressway and a two-level parking garage, and terminating at Larned Street. The main exhibit hall is unique in that it has only two rows of interior columns spaced 240 ft apart transversely and 120 ft longitudinally, five in each row. Sound-absorbing walls suspended in the truss space, located at the third points of the main exhibit hall, can be lowered from ceiling recesses to subdivide the area into three halls of equal size or into two halls, occupying respectively one-third and two-thirds of the total space. Each of the three subdivisions is provided with all the facilities needed for independent use. The main banquet hall can serve 2,800 diners, or when subdivided into two dining rooms, will seat 2,000 and 800. These same rooms, when used as meeting halls, will seat 3,250 and 1,250 respectively. The four meeting rooms west of the main banquet hall have capacities ranging from 100 to 1,050.

Facilities on the third level of Cobo Hall include a 1,500-seat cafeteria with a splendid view of neighboring Windsor, Canada, and its Civic Center; 26 meeting rooms seating from 80 to 820; the building management offices; 6 dressing rooms; and 10 committee rooms. All levels in Cobo Hall are serviced by ramps, escalators, elevators and stairways.

The circular Convention Arena, with a gross floor area of 236,000 sq ft, is scheduled to be opened early in 1961. As with Cobo Hall, the design theme was flexibility. The Convention Arena is suited to accommodate a national political convention, music festivals, boxing matches, basketball, hockey, ice shows and many other events. The building, 315 ft in diameter and approximately 120 ft high, has a permanent seating capacity of 9,560. For certain events, 3,000 additional seats can be placed on the Arena floor. Four sets of pedestrian ramps provide access from the main concourse at the plaza level, downward to the Arena level, and upward to another concourse which provides access to the balcony seating area. The circular structure is functionally self-sustaining. It can be isolated from Cobo Hall for a different use, or wholly integrated with it at all levels. Ancillary areas of the Arena include team and individual dressing rooms, radio and television studios, and press rooms.

Accessibility

The John C. Lodge Expressway, which passes under Cobo Hall, is part of the Interstate highway system. With the toll roads in Ohio, Pennsylvania, Indiana and Illinois, it provides direct access from distant points to the parking facilities in Cobo Hall. A motorist coming from a place on the Atlantic Coast between northern Maine and the Potomac River, from the Wisconsin-Illinois border or from Chicago, can travel via these throughways and expressways and arrive at the roof parking area or in one of the underground parking garages of Cobo Hall with scarcely a stop for a traffic signal. This building has been described as the one most symbolic of

Detroit's Cobo Hall (center of photo) and Convention Arena (circular structure at right) cover 17 acres of ground area.

the motoring age, since an expressway runs through its "basement" and cars are parked on its roof. Fronting on the Detroit River, this building is also readily accessible by water. Those arriving via the Inland Waterway can dock their boats directly at the river entrance.

Design development of Cobo Hall

Steel framing and concrete slab areas of the main exhibit hall floor (above Hall D and the expressway) have been designed to carry live loads of 1,000 psf on the slabs, 300 psf on the full floor area pertinent to the longitudinal beams, and 200 psf on the full floor area pertinent to the transverse girders.

To maintain a ceiling height of 18 ft 6 in. for Hall D, with its bays of 60 ft by 60 ft, it was necessary to design special floor framing for Hall C, which is above it. This framing consists of 36WF beams on 10-ft centers and double 36WF girders. Except for the steel framing for Hall C and for the long plate girders spanning the expressway, the main exhibition floor is of reinforced concrete, designed for a live load of 350 psf. This construction is a typical 12-in. flat slab (with flared column heads and drop panels), except at the north end of Hall A, where the thickened slab extends out 17 ft 6 in. over the Larned Street sidewalk as a cantilever to provide a concourse along the north end of the second floor, and also to provide shelter for the passenger-vehicle unloading zone at street level. The concrete cantilever required special attention since the top steel had to be kept in position by extra-heavy chairs and chair bars. In a cantilever there is only one place where the maximum moments must be taken—at the top of the slab at the support. Therefore it is necessary to make sure that the top steel is in its proper position when the concrete is placed.

The outer edge of the cantilever forms a straight, horizontal fascia extending over 400 ft along the face of the building. To maintain this cantilever level and without waves, it was deemed advisable to specify instrument checking to maintain the proper camber in the forms. Since this cantilever will carry important live and dead loads, the specifications called for special attention in curing the concrete so as to offset creep or shrinkage as much as possible.

These same requirements for heavy chairs and chair bars and for careful curing, were also applied to the design and construction of the concrete cantilever slab of the helical ramp.

Framing for Hall C

The framing and slab for Hall C had to be limited to a depth of 44 in. To maintain acceptable limits of deflection with comparatively shallow construction for the 60-ft spans and heavy live loads, the steel framing was designed for continuity in both directions and for composite action with the concrete slab in positive-moment zones. The beams are 36 WF on 10-ft centers and the girders are double 36 WF's of high-strength steel. The stud-type shear connectors were welded to the top flanges in the field after erection of steel and installation of formwork. The concrete slab, spanning continuously over the 10-ft spans, is of lightweight-aggregate concrete of 3,750-psi strength and a maximum weight of 100 pcf.

The use of lightweight aggregate, shear connectors and high-strength steel, and the need for temporary shoring to obtain composite action for dead as well as live load, might be considered an "extra cost," but it was offset by a saving in the weight of the structural steel in this area and a reduction in live-load deflection.

The 240-ft center spans over the main exhibit-floor area in Cobo Hall consist of trusses 180 ft long by 19 ft 8 in. deep, connected at each end to trusses cantilevered out 30 ft from adjacent 90-ft side areas. The cantilevered trusses are supported by 113-ton carrying trusses—by framing through them.

Framing over expressway

The girders over the six-lane expressway vary in length from 50 ft to 70 ft 6 in. in each of the two spans. This variation in span length is caused by the fact that the expressway passes under the building in a wide sweeping curve. The framing for Cobo Hall in this area consists typically of 48-in. steel plate girders on 15-ft centers, composite in action with the 9-in. concrete slab and continuous (with cover plates) over the center row of columns in the median strip separating the two roadways of the expressway.

Main roof framing

The design of the roof provides for the parking of 1,150 cars and is based on a live load of 75 psf. The roof deck consists of lightweight aggre-

gate concrete 4½ in. thick having a maximum density of 100 pcf, on permanent metal forms. The deck is insulated with asphalt-bound perlite, sealed with a synthetic-rubber modified asphalt and glass fabric membrane, and topped with 1¼ in. of hard-pressed asphalt paving blocks.

The purlins are 18 WF 50's spaced 6 ft 8 in. on centers, spanning 30 ft to the top chords of the sway frames between the main roof trusses. These trusses are part of the 240-ft center spans between columns over the main exhibit-floor area. These 240-ft center spans consist of center trusses 180 ft long and 19 ft 8 in. deep, each weighing 80 tons and suspended at each end on four 12-in. x 1¼-in. links (or bars) They are connected by pins of 4-in. diameter to the 30-ft cantilever ends of trusses extending into the center area from the adjacent 90-ft side areas. These cantilevered trusses, spaced 40 ft on centers, are in turn supported by 113-ton carrying trusses —by framing through them, as shown in a photo—which span 120 ft between the columns. These ten interior columns extend up to the main roof trusses, starting about at the 100-ft elevation between the double columns that carry the double girders at the 124-ft elevation, which is the level of the main Exhibition Hall floor. The main columns weigh 42 tons each and take a column load of 4 million lb, which with the floor load on the auxiliary columns of the first floor, produces a load of 5¼ million lb on each column base plate.

Supported from the roof trusses, along two column lines 240 ft apart, are the suspended "walls" which, when lowered, can subdivide the main exhibit hall of 300,000 sq ft into three fully independent halls. These vertical-lift walls are each 24 ft 9 in. high and 392 ft 6 in. long—more than the length of a football field. Each wall is divided into 8 sections. The cost of these two giant motor-driven dividing walls was $362,000, an installation of a type previously used only for power doors in aircraft hangars.

Helical ramp

Cars reach the roof parking deck by a circular ramp 188 ft in outside diameter at the southwest corner of Cobo Hall. This triple-lane ramp, designed for a live load of 80 psf, consists of structural steel girders spanning between steel columns, all encased in concrete. From these steel girders the concrete deck cantilevers out from 17 to 20 ft beyond the girders. The curved section of the ramp, superelevated 2 ft in the curb width of 45 ft 6 in., rises 45 ft in making 2¼ turns and, with the tangent approaches, has a total rise of approximately 59 ft. In the 1½ in. top wearing surface of rubber-modified asphaltic concrete are embedded electric heating elements to combat snow and ice.

Electrical and mechanical facilities

The Public Lighting Commission supplies the power to the three main transformers, each rated at 7,500 kva. Distribution to 11 unit substations rated at 2,000 kva is by underground duct system at 4.8 kv. Power distribution to motor and lighting control centers is four-wire 480/277 v. The Detroit Edison Company supplies steam at 30 psi for all heating requirements from its central heating plant one block to the north of Cobo Hall. Four water chilling machines provide 5,120 tons of refrigeration for the air-conditioning system of Cobo Hall and the Convention Arena and for two other Civic Center buildings, the Veterans Memorial Building and the Henry and Edsel Ford Auditorium.

Embedded in the concrete slabs of the exhibition floor are mechanical and electrical service boxes for the connection of equipment in any location. The mechanical service boxes, one for every 830 sq ft, provide for drains, water, gas and compressed air. The electric-power service boxes and telephone-outlet boxes, one for each area of 470 sq ft, provide service capacities comparable to the requirements of a city of 8,000 population.

Traffic between floors, for both pedestrians and vehicles, is well provided for. Interior ramps on easy grades will handle pedestrian and industrial truck traffic. The ramped street along the west side of Cobo Hall provides access for even the largest trucks up to the second floor level and to the loading docks, which are equipped with self-adjusting dock levelers. Besides the usual stairs and elevators, escalators provide for high-capacity pedestrian travel. These escalators, because of the 24-ft story height between the first and second levels, are the longest in Detroit. They are the most modern available, equipped with the latest safety features and ample in width to handle the anticipated crowds.

Convention Arena

The Arena Building, which is circular in plan, has a floor designed for exhibitions, displays and sports events

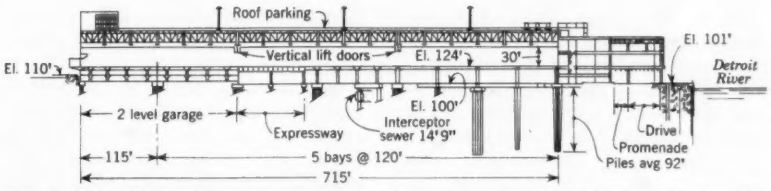


FIG. 1. Cobo Hall extends some 900 ft northward from the Detroit River. Part of the building spans a six-lane expressway.

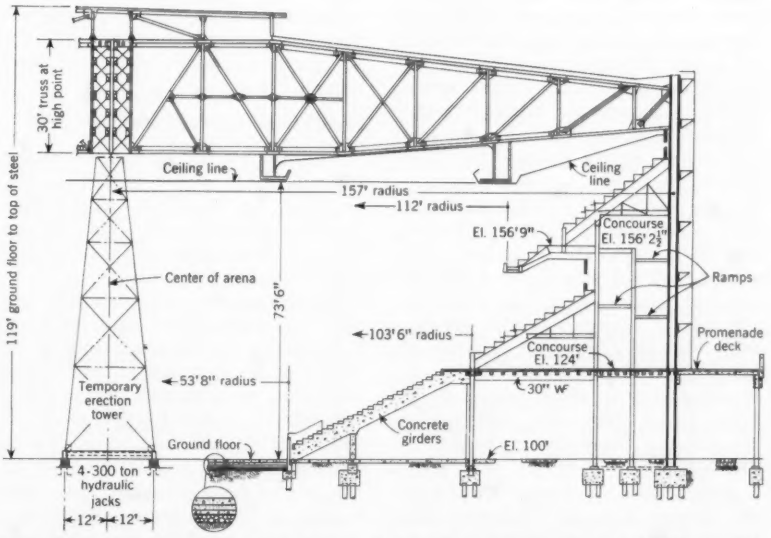
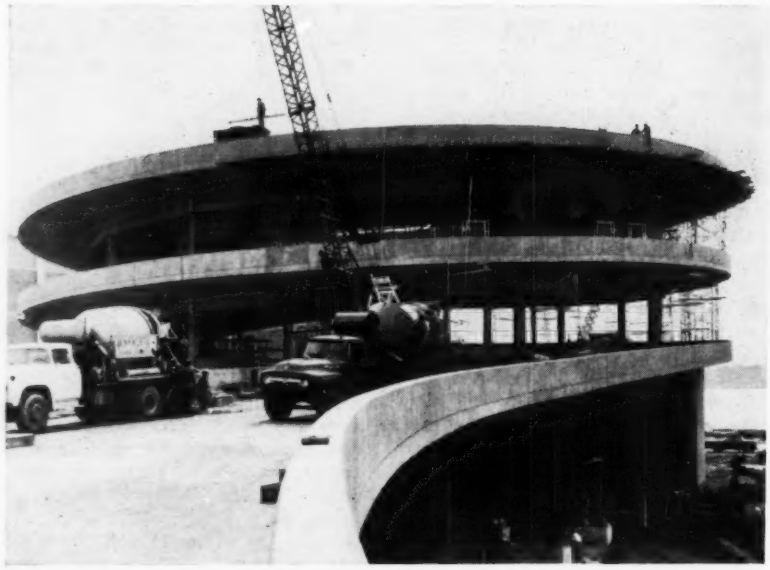


FIG. 2. The circular Convention Arena, designed to accommodate exhibitions, displays and sporting events, has a seating capacity of 9,000.



A circular ramp 188 ft in diameter provides access for cars to the roof parking deck of Cobo Hall. This triple-lane ramp makes 2¼ turns in rising 45 ft. Including tangent approaches, total rise is 59 ft.

as well as ice skating and hockey. It can be prepared for the ice events by flooding and freezing, using an embedded piping system for refrigeration.

In the attic space above the acoustical ceiling, there are walkways and platforms between the trusses to permit servicing of the ventilation, lighting and public address systems. There is also a "fly loft" for raising and lowering scenery for theatrical productions.

The need to minimize the interior cubic content of the arena audience zone for optimum acoustical conditions dictated a ceiling profile sloping downward from the outer wall toward the center. This in turn indicated radial roof trusses of simple span, spliced to a common "hub," with the bottom chords approximating the general profile of the ceiling. The roof framing thus forms a radial pattern—like the spokes of a wheel radiating from a hub section 11 ft in diameter and 30 ft high. The 16 main spoke trusses (HT 30), when spliced through the hub section, span 315 ft to the 101-ft-high columns at the exterior wall. The splice plates at the top and bottom of the "hub" are 15 ft 3 in. in diameter, 1½ in. thick, and made of high-strength "fire-box" steel having an ultimate strength of 80,000 to 100,000 psi.

Intermediate between the main HT 30 trusses are the shallower T 31 trusses which, instead of extending to the center of the hub, where there would be no room for connections, frame into sway frames which carry the inner reaction back to the HT 30 trusses. An accompanying photograph shows the 27-ton hub section being set on a temporary erection tower at the center of the Arena span. The hub was hoisted in place by two 160-ft cranes. The temporary erection tower was removed after the lower-level concrete work (ramps and floors) was in place to brace the frame as a whole. It took quite some time to place this lower-level concrete, and during this time the general public had the usual opinions as to why the tower remained in place so long. However, when the tower was removed, the deflection was just 2 in. as compared with the computed deflection under the dead load of 2⅜ in.

Foundations for Cobo Hall and Arena

This site on the Detroit River is a historic one. Cadillac landed on this shore of the "strait"; the fabled Maj. Robert Rogers with his rangers camped here; and the great Indian leader Pontiac fought here.

In subsequent years, the river was filled in, docks were built on piling and abandoned, the basements of deserted buildings caved in, and sewers were run underground. As a result, obstructions were encountered at unexpected locations and levels. Therefore, along the present river front, the ground floor is supported on piles spaced 15 ft on centers both ways.

Generally speaking, the whole site is covered with a soft blue clay to depths of about 100 ft, where a substantial bearing stratum is reached, a hardpan varying in thickness from 5 to 20 ft. Just below the hardpan a fissured limestone bedrock is usually found. Often when the hardpan is penetrated just above the rock, an artesian water head together with hydrogen sulfide is released from the fissures and voids. The hardpan stratum has a bearing value exceeding 20 tons per sq ft and an ultimate bearing just above the rock level (at −90 ft to −97 ft) of several hundred tons per square foot.

Wet, rotary, pre-excavated, step-tapered, cast-in-place concrete piles were used on this project. The permanent steel shells of the piles were driven with a heavy-wall, full-length mandrel, to hardpan or rock for a rated capacity of 100 tons per pile, except for the ground-supported floor slab and other lightly loaded pile groups, for which 60-ton piles were driven. The factor of safety for the piling was determined by test at approximately 3. Huge pile-driving equipment was required for this job on account of the pile lengths involved. For the upper part of the 100-ton-capacity piles, 96 ft of corrugated steel shell, stepped at 24-ft intervals, was used. The lower 8 ft of shell consisted of pipe with an outside diameter of 12¾ in. and a wall thickness of ¼ in. The 60-ton piles consisted of an 8-ft bottom section 10¾ in. in outside diameter and 96 ft of corrugated shell stepped at 16-ft intervals. The piles were filled with 4,500-psi concrete.

Certain piles were tested under 600 tons of steel slabs in a test program carried out by the Engineer Research Institute of the University of Michigan. Two-cycle loading graphs and charts were made for yield value, elastic limit and time-load settlement. The test results determined the pile capacities. The piles tested were in the group of 15 for the first column footing installed. The group is arranged in 3 rows of 5 piles each. Tests were made on 4 individual piles in this group.

Approximately 4,500 piles were driven, with an average length of 90 to 97 ft and a total footage of 400,000 lin ft. Approximately 26,000 cu yd of concrete were used in the piles and pile caps. The largest group was made up of twenty-nine 100-ton piles.

Structural steel details

Field connections consisted of 400,000 high-tensile-strength bolts with hardened washers. The quality of installation was controlled by a testing laboratory through inspection of all bolt-tightening equipment and com-

pleted connections. Impact wrenches were calibrated daily for the size of bolt being placed.

The 113-ton longitudinal carrying trusses for Cobo Hall were given special adjustment of connections to columns to avoid excessive secondary stress in the end panels of bottom chords. After the concrete roof slab was poured, the adjustment was made by loosening all the bolts in a bottom-chord column connection and then tightening them one by one. The connections at the next column were then loosened and the bolts individually tightened. In this way the adjustment progressed along the entire truss line, one truss at a time, until all connections at the designated columns had been stress relieved.

Truss connections in the Arena Building were also adjusted to eliminate the major part of the dead-load secondary stresses. The connections of bottom chords to columns were not made permanent until after the roof framing was completed and all bracing and spandrel beams between the exterior columns had been erected. Then the jacks under the temporary erection tower supporting the roof framing were gradually lowered until the full load of the roof truss system was supported on the columns, at which time the bottom-chord connections were shimmed and made permanent.

All the large base plates were shipped loose with the top surface milled and the plates drilled and tapped and provided with screws for leveling. The plates were also scribed for accurate alignment and equipped with holes for grouting. The other base plates—those for the light columns—were shipped attached.

All the trusses were cambered so that they would assume their proper positions under full dead load plus one-third of the live load.

The high-strength structural steel had a minimum yield point of 45,000 psi. All shop connections were riveted and standard machine field bolts were permitted, in general, for purlins, girts, minor struts, fan-room platforms, ceiling framing and secondary members not forming a part of the bracing system. The pins for the suspended-truss links were cold-rolled steel, true to size, shouldered, with threaded ends and hex nuts. The pin plates (hanger bars) were drilled in sets with the pin holes $\frac{1}{64}$ in. larger than the pin diameter.

Concrete for the project

Lightweight concrete was used to great advantage on this project. Use of expanded shale for the aggregate resulted in a concrete with a maximum density of 100 pcf. The lightweight concrete used for all floors supported on steel framing and for the helical ramp had a strength of 3,750 psi at 28 days, except in the meeting and banquet hall section of the building, where the 28-day strength was 3,000 psi.

The regular-weight concrete, using crushed rock or slag as coarse aggregate, had a 28-day strength of 3,000 psi. This concrete was used for all other construction except mud mats, which were of 1,500 psi concrete.

The maximum slump allowed was 3 in. for lightweight concrete, and 3½ in. for regular concrete. Laboratory-cured and job-cured cylinders were required to have, at 7 days, 80 percent, and at 28 days, 115 percent, of the 28-day design strength specified.

For reinforcement, intermediate grade, new billet or rail steel was required. Column spirals are cold-drawn wire with a minimum yield strength of 60,000 psi. The welded wire fabric was cold-drawn.

Where the main exhibit floors are of concrete, they are of regular 12-in. flat-slab construction with drops and caps. Bays are approximately 30 by 30 ft. The cantilevered slab for the north concourse varies in thickness from 24 in. at the haunch to 6 in. at the free edge, using concrete with a 28-day strength of 3,750 psi.

The lower parking level of Cobo Hall (at El. 111) is of regular concrete in a 9½-in. flat slab with caps, utilizing concrete with a 28-day strength of 3,000 psi. The bay size is 28 ft by 29 ft 6 in., with a design live load of 75 psf. In meeting and banquet halls, the floors are of lightweight structural-concrete joist construction in 30-ft spans supported by steel framing. The 28-day strength is 3,000 psi with a design live load of 100 psf.

In the Arena underground parking garage all the levels have bays 28 by 30 ft. The following criteria govern floor construction. For the foundation, inverted flat slab 24 in. thick is used with drops 42 in. thick using regular concrete and a soil pressure of 2,000 psf. At the first parking level, 10-in. flat slab is used with caps, all of regular concrete with a 28-day strength of 3,000 psi and a design live load of 75 psf. The roof has a 16-in. flat slab with drops and caps, of regular concrete with a 28-day strength of 3,000 psi, a design live load for H20-S16 loading, or a 600-psf uniform load due to a 200-lb live load plus 4 ft of earth fill. Ultimate design theory was used for axial loads and combined bending on columns. Minimum sizes were used for the columns because of parking restrictions.

Hub section of the Arena Building, weighing 27 tons, rests on a temporary erection tower. The tower was kept in place until concrete work at lower levels was in place to brace the frame as a whole.

In the Arena Building the lower seating tiers will be of regular concrete poured in place. Its 28-day strength is to be 3,000 psi. The steel-pan balcony seating tiers will receive a lightweight concrete fill with a 28-day strength of 3,000 psi.

To secure quality control of the concrete on the job, several methods were employed. The moisture content was controlled by prewetting the piles of aggregate. A close check was maintained on field yield, plastic weight and slump. Full-size field trial mixes were tested under actual conditions, and checks were made on the air content. Air entrainment was controlled by forbidding any air-entrainment agent in any of the ingredients or additives, except the additive for that purpose. Control was well maintained throughout the placing and finishing of the concrete by close field supervision.

Giffels & Rossetti, Inc., of Detroit, Mich., are the architect-engineers for Cobo Hall and the Convention Arena. For the foundations, Darin & Armstrong, Inc., of Detroit was the contractor, with Raymond Concrete Pile Company as piling subcontractor. For the superstructures the general contractor is O. W. Burke Company of Detroit. The structural steel contractor was R. C. Mahon Company of Detroit, who subcontracted a third of the work to Whitehead & Kales Company of River Rouge, Mich.

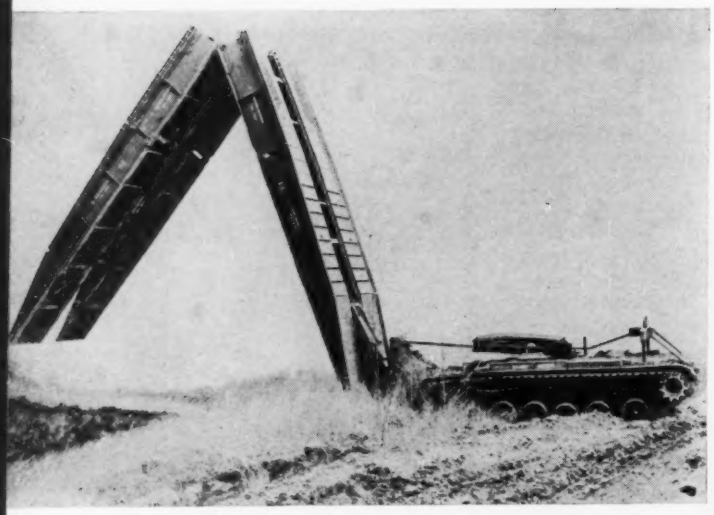
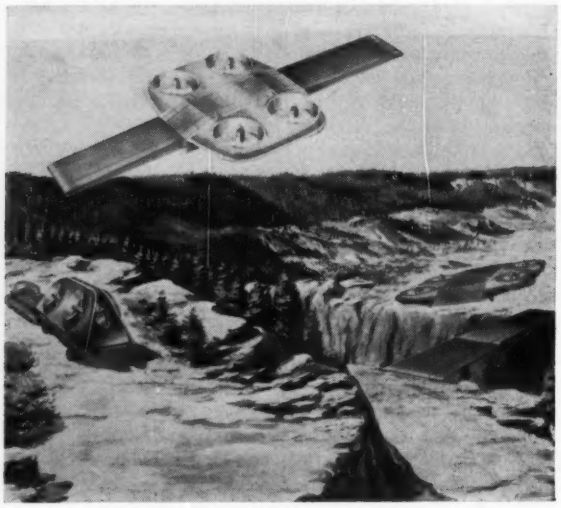


FIG. 1. "Scissors" bridge, considered an interim solution, is carried and launched hydraulically by a turretless tank.

FIG. 2. "Flying carpet," for spans up to 90 ft, is planned for placement by a remote operator up to 50 miles away.



The missile age in civil engineering

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Fort Belvoir, Va.

The Corps of Engineers is the oldest technical service of the Army, and its original activities were almost exclusively in the area now designated as civil engineering. Because of this background, the Corps has been designated as the agency to perform most of the governmental activity in navigation, flood control and related federal construction as well as construction of Army and Air Force facilities.

Most civil engineers know of the civilian work of the Corps but very few are aware of the extent to which the Corps has developed civil engineering in its military responsibilities. Discharge of its military responsibilities requires the Corps constantly to look into the future to insure that our capabilities remain second to none. This forward look frequently results in the Corps' being supplied with equipment considerably in advance of that in use in civil life.

The military mission of the Corps of Engineers is to enhance the mobility of our own forces and to impede the mobility of the enemy. In the performance of this mission the Corps has been assigned responsibility in many project areas, not all of which are civil engineering. See Table I.

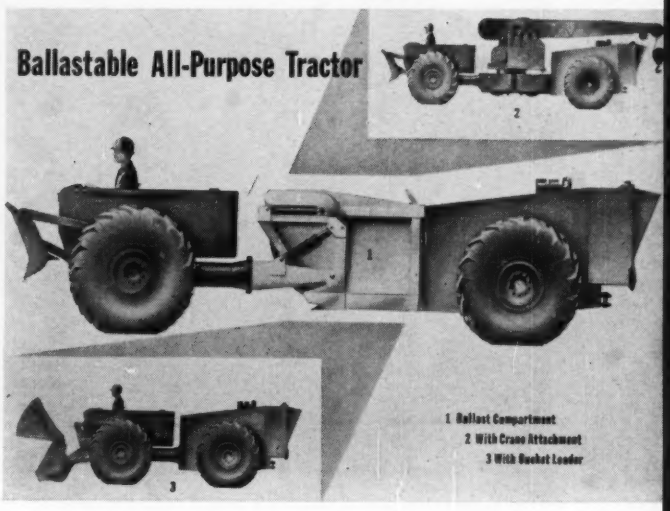
The present concept of Army organization and tactics to cope with the problems presented by the atomic age calls for extreme mobility. The Army of the future must be able to move rapidly and at will to fight successfully on the battlefield. As far as possible it should be self-contained with a minimum of reliance on a ponderous logistical tail. The Corps of Engineers' responsibility for mobility under these conditions imposes challenges which the laboratories are rising to meet.

The Engineer Research and Development Laboratories (ERDL) at Fort Belvoir, Va., is the principal military research and development agency of the Corps. Facilities for work in soils, concrete and trafficability at the Waterways Experiment Station (WES) at Vicksburg, Miss., and for cold regions research at the Snow, Ice and Permafrost Research Establishment (SIPRE) at Wilmette, Ill., round out the research family. ERDL employs about 1,400 civilians who are supplemented by some 250 officers and enlisted men. About 450 of the civilians are classed as professional people with training and skill in either science or engineering or both.

Civil engineering accounts for a

FIG. 3. Adaptation of commercial air mattress is expected to be inflated at site and launched with help of ram jets.

FIG. 4. Revolutionary airborne, air-droppable tractor weighs less than 16,000 lb but is ballastable to 35,000 lb.



A Corps of Engineers viewpoint

large fraction of the laboratories' effort. It is believed that a description of some of this work at ERDL and a look into the future, as the laboratories see it, will be of interest to civilian engineers.

Bridging and stream crossing

Although much has been said and written about the use of planes, helicopters and ground-effect machines for the transportation of personnel, it is probable that the Army will be dependent on bridges and ferries for river crossings for a long time. While we continue to improve our existing bridge equipment and to develop better erection techniques for it, our principal efforts are directed toward new and novel ways of keeping our forces on the go. The helicopter is helping to solve this problem with the lighter bridges. Tests have been held to determine the possibilities of delivering bridge and supporting equipment to the site by air. Using the H-21 helicopter, which has a load-carrying capacity of about 3,000 lb, the following have been successfully air-lifted: a complete bay of the 12-ton-capacity light tactical bridge, floats of the widened steel treadway bridge, superstructure for these floats, the 19-ft bridge erection boat, and eight nested assault boats. With the H-37, a heavier helicopter, it is possible to air-lift the pneumatic float of the M4T6 bridge and then place the aluminum deck on it.

Assault bridges must be placed, picked up and moved in rapid fashion to provide the desired mobility. One solution is the recently developed "scissors" bridge (Fig. 1). Made of aluminum alloy, this bridge is carried and hydraulically launched by a modified, turretless tank. The bridge comes in two sizes—40 and 60 ft—both utilizing the same launcher. Eighteen launchers, a like number of 60-ft bridges, and nine 40-ft units are being procured for issue to armored units both stateside and in Europe. The "scissors" bridge is considered only an interim solution to the assault-bridge problem. Looking into the future, bridges must be even more mobile. One favorable requirement is that future bridges will not be required to carry heavy loads.

The urgent need for radical types of bridging calls for wholesale imagination on the part of our engineers. Feasibility and preliminary design

TABLE I. Project areas assigned to Corps of Engineers

Bridging and Stream Crossing
Buildings and Utilities
Cold Regions Research
Combat Mapping and Geodetic Systems
Concealment and Deception
Construction and Maintenance
Electrical Power
Fire Fighting
Fortifications, Obstacles, and Demolitions
Ground Mobility Research
Industrial Engines
Infrared Research
Land Navigation
Liquid and Compressed Gases
Liquid Fuels Distribution
Map Compilation
Map Reproduction
Mapping and Geodetic Research
Materials Research
Mine Warfare
Mine Warfare Research
Night Vision
Nuclear Power
Nuclear Weapons Effects
Port Facilities
Surveying and Geodesy
Water Supply and Sanitation

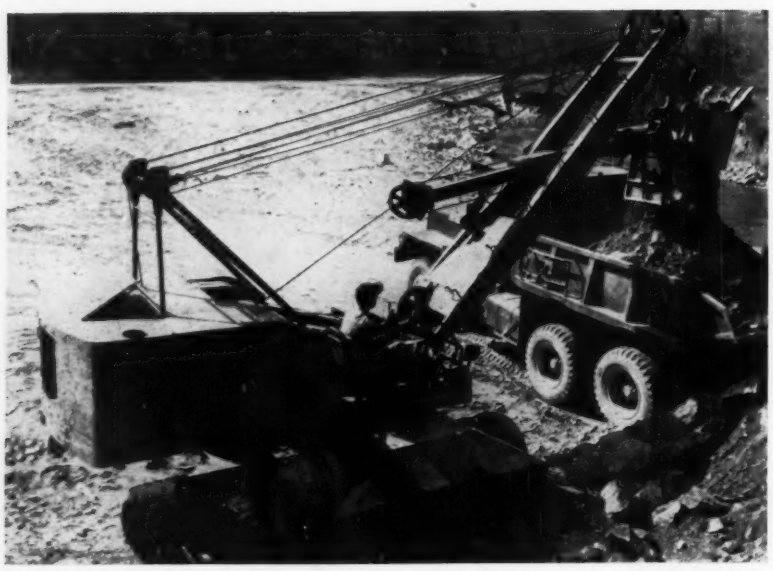


FIG. 5. Airborne crane weighing only 8 tons can pick up 9-ton load or serve as an excavator.

studies are being conducted on a number of unconventional devices.

A "flying carpet," illustrated in Fig. 2, will be capable of supporting light military loads over spans up to 90 ft. Battlefield TV systems will be utilized to allow its remote operator to emplace the device at distances up to 50 miles away.

In Fig. 3 is shown an adaptation of a commercial air mattress made of nylon-impregnated rubber or similar material. We expect to carry deflated mattresses on trucks or trailers to a point near the launching site, where they will be inflated and readied for launching with the help of ram jets. The jets will propel the bridge as well as support its forward end. Small samples of load-carrying pneumatic structures have been fabricated by interested rubber companies. This type of structure definitely warrants further consideration. Other equally imaginative devices have been proposed.

A unit that will have all the equipment necessary for field fabrication of precast prestressed concrete bridge structures for use in line-of-communications operations has been proposed. Through the use of indigenous materials and with complete facilities for processing the raw materials and for batching, placing, forming, curing and testing, the Engineer Construction Battalion becomes a self-sufficient unit in any locality. The precast sections will be stockpiled and, when needed, the required number of sections, anchorages, and lengths of cable will be furnished for the construction of bridges of various spans and roadway widths. The use of locally produced prestressed concrete sections will greatly reduce the logistic requirements for materials.

Construction power

Construction power will play a key role in any future conflict, whether it be atomic or non-atomic. Equipment, methods and techniques must be developed to give our construction troops the capability of constructing any facility needed to support our mobile forces.

An accelerated airborne construction equipment program has produced a family of machines capable of building an assault airstrip 1,500 ft long and 100 ft wide within 12 hours after the air-drop.

Although this seems to be an outstanding accomplishment, it falls far short of meeting the new requirements imposed by the streamlined airborne divisions. The Engineers are now faced with the problem of providing troops with the capability of building assault airstrips within 5 hours after the drop. Since the amount of engineer equipment in the Airborne Division is limited, it means that the equipment now available must be improved to the point where production capabilities are more than doubled.

Under development to meet this need is a revolutionary ballastable airborne, air-droppable tractor shown in Fig. 4. This machine weighs less than 16,000 lb in its transportable condition, but is ballastable at the work site to do the work of a 35,000-lb tractor. Actually, it is intended to be a multi-purpose machine—one that will not only perform the work of a dozer, but a scraper, grader, dump truck, and prime mover as well. Also under development is a crawler version of the ballastable all-purpose tractor, also designed to be air-droppable and ballastable up to 35,000 lb.

The commercial crane also falls far short of meeting battlefield requirements. So again military "specials" must be developed to meet the demand for mobility. Under test are two types of machines designed for off-road operation. The airborne crane shown in Fig. 5 is close to the hands of troops. It is a powerful little machine weighing only 8 tons, but can pick up 9 tons. This unit tows readily at convoy speeds, has a self-propelled speed of 8 miles per hour, and can be converted to perform the operations of a ⅜-cu yd clamshell, dragline and front-loading shovel.

In the engineering test stage is a rough terrain crane with a capacity of 20 tons at a 30-ft radius. This machine features 4 x 4 drive, large wide-base tubeless tires, and an integral inflation-deflation system which provides mobility over rough terrain, and the necessary flotation for operation on beaches and in mud. The unique inflation-deflation system makes it possible for the operator to obtain maximum mobility from the tractor. He can adjust the pressure in all tires up to 80 lb per sq in. by manipulating a master control valve in the cab to cope with the types of terrain encountered in his cross-country movement.

A high-speed intrenching machine has been developed for personnel protection against flash burns and radioactive blast. It can dig one- and two-man foxholes in a minute under favorable soil conditions. It can dig heavy machine-gun emplacements in a little over three minutes and large horseshoe-type emplacements in five minutes. See Fig. 6.

Rapid survey equipment

Rocket and missile developments have added many challenging problems to our surveying and mapping program. Foremost among these is the increased requirement for mapping and geodetic data to support artillery and missile operations.

One of the major early objectives in this program is the development of an artillery survey system which will enable a survey team to establish 12 to 14 initial control points in an area 40 miles square within 45 minutes or less. The minimum accuracy required for these points is 1:3,000 in position and 20 seconds in azimuth. Every known development that will contrib-

ute to the advancement of this system is being exploited. Besides domestic developments the latest foreign developments have been purchased for testing. The Union of South Africa is furnishing ground and airborne tellurometers to measure distances, and has developed a portable short-range electronic positioning set for rapidly extending survey control points in the field artillery battalion and battery areas. Japan has contributed the electronic-transit-detector principle used in an automatic tracking theodolite, and automatic positioning survey equipment. Switzerland is providing the optical-reading theodolites of various accuracies, and Germany's advancement in the development of gyro orientors is paralleling our industry.

The principal items being investigated for possible use as components of the final system are the tellurometers, the automatic tracking theodolite, aerial flares or lights and a computer. The new tellurometer is an electronic instrument that rapidly measures baselines with a constant error of only 5 centimeters, and an accuracy loss of only 3 parts per million from varying weather conditions. Now under quantity procurement, it has a range of 40 miles.

With two positions and a baseline established, it is possible to extend the control to 12 or 14 positions over the 40 x 40-mile area. This can be done with either the airborne tellurometer or the automatic tracking theodolite. With the airborne tellurometer, three radio waves of different frequencies within the 1215-1400 megacycle range are radiated from the airborne station. These carrier waves are modulated by measuring frequencies of 1.5 megacycles. The modulated waves are received at their respective ground stations, two of which are known points, the third an unknown point. From there they are retransmitted to the airborne station where the returned waves are compared with their respective transmitted waves. The subsequent recording indicates the phase shift between the outgoing modulated waves and their respective incoming waves. During the electronic measuring procedure, meteorological readings are obtained for use in determining the final geodetic distance from the observed data. These geodetic distances are used to compute the location of the unknown ground station in relation to the two known ground stations.

The automatic tracking theodolite is designed to establish the initial survey points in the 40-mile-square area. Starting from a given baseline, simultaneous observations on airborne flares or lights by automatic theodolites located at unknown ground stations will facilitate position computation of these points. This item is dependent upon good radio communications and data transmission. It is also dependent upon the visibility of the flares or lights.

Automatic positioning survey equipment is also under development for use when there are no given survey control points to start the survey. This scanning device will rapidly observe a number of stars, and transmit data to a computer, which will automatically solve the astronomic triangle and print out the astronomic position of the observer. See Fig. 7.

Another aspect of the missile support program is the requirement for means of rapidly extending control of high accuracy over great distances. This is essentially a problem of processing large quantities of terrain data gathered by an airborne sensing device. Present methods of extracting the required information from aerial photographs or radar presentations and compiling this data in the most useful form are much too slow for the modern army.

Work is currently under way toward automatizing and speeding the stereophotogrammetric procedure of compiling maps from aerial photographs. In addition, studies are being directed toward the development of a digital map compilation system that will automatically and rapidly compile topographic data by converting information from aerial photographs directly into digital form and correlating detail in a high-speed electronic computer.

Mapping for mobility

In any future war the army will need more maps than ever for troop units constantly moving on a widely dispersed battlefield. Mobile mapping vans are already available, but the standard reproduction methods now utilized are too slow. A new and novel printing technique called Xerography, or electrostatic printing, is being developed to meet the demand for rapid means of producing maps in the field. Electrostatic printing is based on the fundamental phenomenon of the mutual attraction between particles having an opposite electrical charge. The heart of the process is a photoconductive coating. This coating has the unique property of being an electrical insulator in the *absence* of light, and an electrical conductor in the *presence* of light. A combination of these two phenomena results in the basic principle required for electrostatic printing.

Engineering tests will soon start on a machine built under contract by RCA. This machine utilizes a web of

FIG. 6. High-speed intrenching machine digs foxholes for protection against flash burns and radioactive blast.

binder-coated paper, 22½ in. wide. Weighing 1,100 lb, it is capable of printing single-color maps, in limited quantities, at a rate of 2,000 impressions per hour, and experimental-type multicolored maps can be printed by repeated passes. (See Fig. 8.) In operation, the paper first passes a charging station, where it receives a blanket negative electrostatic charge. It then passes the exposure station, where it is exposed to the projected image of a 70-mm positive separation by an electronic flash. The charged and exposed

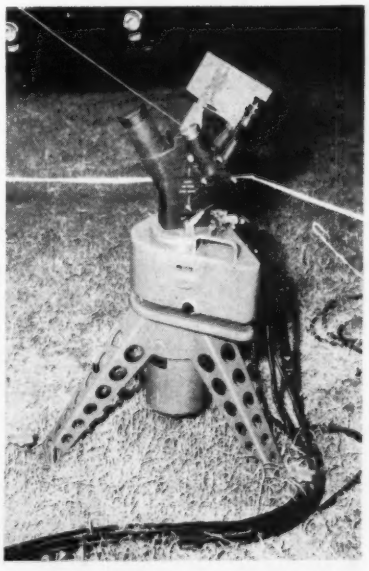


FIG. 7. Automatic position indicator rapidly determines astronomic location of the observer.

FIG. 8. RCA electrostatic printing machine can produce single-color maps at rate of 2,000 impressions per hour.

FIG. 9. Water purification unit, with capacity of 3,000 gph, removes radiological as well as conventional contaminants.

paper is then developed with a toner of the appropriate color. The machine is capable of running up to four additional colors.

The most outstanding advantage of electrostatic printing over the conventional offset printing process is the tremendous saving in time and money realized by the elimination of the plate-making step. Additional benefits will be reaped as technology advances in the field. For example, the machine's top speed of 2,000 impressions per hour is expected to be increased to 7,000 per hour by the use of faster mechanisms.

The machine is the first phase in the development of an entirely new system for map reproduction, storage and issue. Under development is a device which will automatically locate in only 15 seconds any desired film transparency map from a compartment containing more than 11,000 different 70-mm microfilms. This unit is basically an optical-electromechanical device consisting of a multi-decked storage drum holding the microfilms, a movable film pick-up assembly, and a projection display assembly. In use, the operator will dial a number as one would on a telephone. The unit will then automatically select the correct map film from the compartment, and carry it to a rear screen projector for immediate viewing on a large screen.

Looking ahead, studies are being directed toward an ultimate system for the collection, storage and utilization of vast amounts of data. A satellite is being considered as the collecting agent. This satellite would gather, and either transmit or return to earth, the necessary information. This information, together with data on the satellite's position, would be reduced and plotted by electronic means to provide presentations of all areas of the earth's surface.

Water purification

Water purification is a matter of grave concern, particularly if our troops are involved in a war of atomic weapons. The decontamination of radioactively contaminated water is also a common problem in peacetime. Contaminants include waste products from atomic energy plants, laboratories and hospitals, fall-out of fission products, induced activity in the dissolved mineral matter in the water, and blow-in or wash-in of radioactive dust or soil.

The Sanitary Engineering Branch of ERDL has met the problem by the development of a family of purifiers capable of removing bacteriological and chemical warfare agents as well as radiological and conventional contaminants. Operated according to standard procedures of coagulation, filtration and disinfection, a safe 85 percent of gross fission products can be removed. The removal can be increased to 93 percent with a clay pretreatment, and to 99.9 percent with a post-ion-exchange treatment. The unit shown in Fig. 9 has a capacity of 3,000 gal per hour (gph). Others in the family include 600 and 1,500-gph capacity mobile purifiers, and a fired water plant capable of producing 10,000 gph of drinking water.

The problem of purifying salt water is also under attack. Years of research on the use of non-critical and seawater corrosion resistant materials in distillation equipment have resulted in a thermocompression distillation unit utilizing aluminum evaporator and heat exchange components. It is a self-contained 125-gph unit which weighs only 2,800 lb as compared to the 6,000-lb standard unit of 60 gph.

FIG. 10. Army Package Power Reactor, located on ERDL grounds at Fort Belvoir, is prototype of a family of plants under development for use at remote bases.

Nuclear power

Not strictly civil engineering but closely related, is the development of nuclear power. The use of atomic energy as a source of electric power and heat for military purposes has been under development the last few years by the Office of the Chief of Engi-

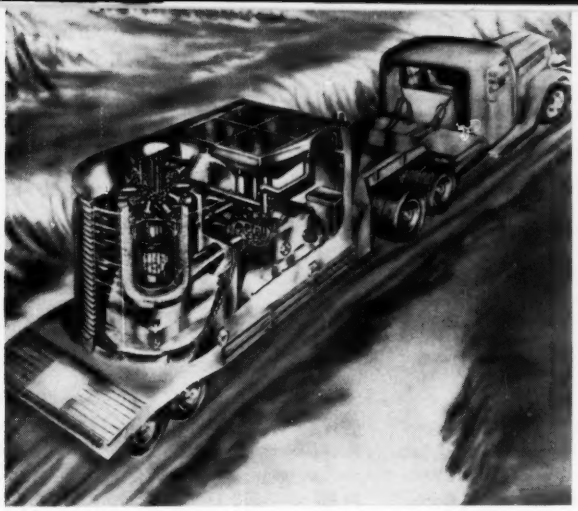


FIG. 11. Trailer-mounted power reactor is under development at Fort Belvoir laboratories.

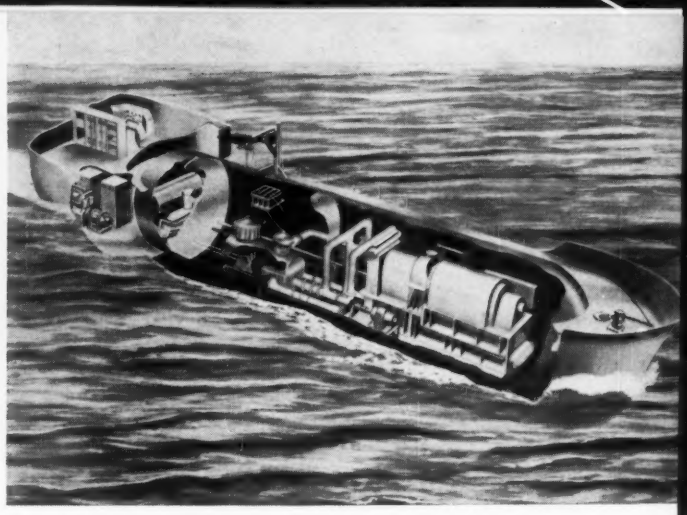


FIG. 12. Another power reactor is being developed for mounting on a barge.

neers and the Atomic Energy Commission. The present objective is a family of stationary, portable and mobile plants to meet the military requirements of all three services. The nuclear power program is important because virtually every technological advance in military equipment is accompanied by an increased requirement for electric power.

The Army Package Power Reactor, located on ERDL grounds at Fort Belvoir (now called the SM-1, stationary, medium power plant, type 1) (Fig. 10), is the prototype of a family of plants under development for use at remote bases. Its components are transportable by air and capable of erection within a six-month period. The plant went into service in April 1957 and has been producing electricity at a rated capacity of approximately 2,000 kw. A similar plant with twice the power level is being built in Alaska. Another smaller plant, sized for application on a DEW Line station, is producing electricity at the National Reactor Test Station in Idaho. Succeeding plants of different sizes and types are in various stages of planning and development. They include a trailer-mounted plant, and one that will be mounted on a barge as illustrated in Figs. 11 and 12.

The research and development process carries an item of equipment through many tests before it is adopted by the Army. Accordingly, laboratory equipment is varied and complete, with desert, arctic and tropical stations available for environmental tests.

Pilot models of bridges are subjected to several series of tests, including structural tests. During this series, a bridge undergoes a prearranged schedule of both static and dynamic loads designed to simulate its actual field use. The purpose of these tests is to discover not only the ultimate capacity of the bridge, but also to make possible the assignment of narrow margins of safety. Often, the precise capacity is determined by loading excessively until failure occurs. Electrical strain gages are used extensively to determine actual stresses in bridge members under test. A machine capable of applying loads up to 400 tons on experimental bridges is shown in Fig. 13. There are also facilities for tests on liquid fuel pumps, filters, water-gasoline separators, pipes, valves, hoses, storage tanks, and flow and pressure measuring devices.

Typical of environmental testing is the Greenland trial of a "Wanigan" or mobile arctic home, shown in Fig. 14.

Finally there is the matter of personnel. No organization can be any better than the people of which it is composed. A high-level research activity cannot be supported by mediocre people. Accordingly, the Corps actively encourages the personal development of all of its personnel. A comprehensive program of training, both executive and scientific, has been established. Many persons have been sent to seminars and workshops of the American Management Association. Many others from ERDL are enrolled in one or more of the universities in the Washington area where they are improving their abilities in subjects ranging from bookkeeping to higher mathematics and nuclear physics. Such training is necessary if the laboratories are to maintain the position of leadership necessary to accomplish their mission.

(This article is based on a talk by Mr. Hickox before the Tennessee Valley Section of ASCE.)

FIG. 13. Machine capable of applying loads up to 400 tons on experimental bridges is in use in Fort Belvoir laboratories.

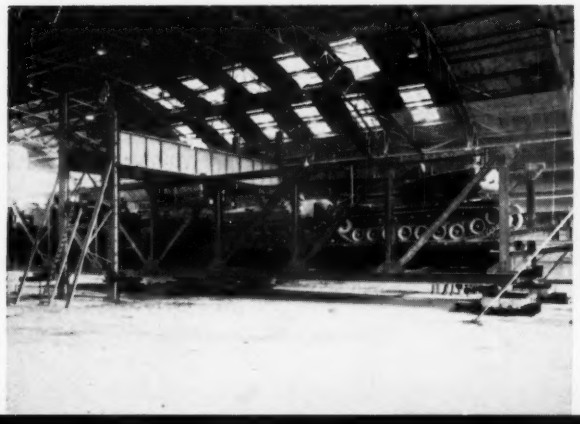
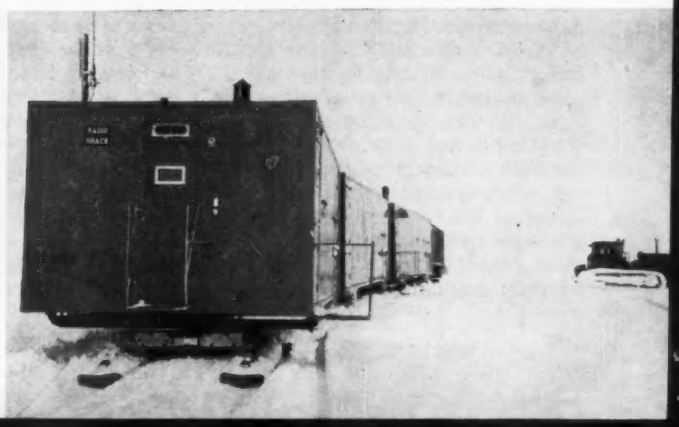


FIG. 14. Typical environmental testing is being carried out in Greenland on a "Wanigan" or mobile arctic home.



ASCE NEWS

Water Resources Research

Throughout the discussions held in Washington during the USPHS-organized Conference on Water Pollution (January issue, page 46), civil engineers were vocally aware that money, facilities, and great competence would be required to carry out the ambitious programs that were described. With foresight, one panel of the conference lent its time and effort to analysis of this set of circumstances.

Invited to serve on the panel were: Charles A. Bishop, director, Chemical Process Development, U.S Steel Corporation, Pittsburgh; Claire S. Boruff, technical director, Hiram Walker and Sons, Inc., Peoria, Ill.; Karl Brandt, member, Council of Economic Advisers, Washington, D.C.; R. Keith Cannan, chairman, Division of Medical Sciences, National Research Council, Washington, D.C.; Rolf Eliassen, F. ASCE, professor of sanitary engineering, Massachusetts Institute of Technology, Cambridge, Mass.; Gordon M. Fair, F. ASCE, professor of sanitary engineering, Harvard University, Cambridge, Mass.; Richard Hazen, F. ASCE, partner, Hazen & Sawyer, New York, N.Y.; Chauncey D. Leake, dean and professor of pharmacology, College of Medicine, Ohio State University, Columbus, Ohio; Erman A. Pearson, M. ASCE, associate professor of sanitary engineering, University of California, Berkeley, Calif.; Gerard A. Rohlich, F. ASCE, professor of sanitary engineering, University of Wisconsin, Madison, Wis.; Gilbert F. White, professor of geography, University of Chicago, Chicago, Ill.; and John A. Zapp, director, Haskell Laboratory, E.I. duPont de Nemours, Newark, Del.

Facilitating their studies were resource personnel assigned by the USPHS—B.B. Faber and H.A. Faber. The report of the panel follows:

Sanitary engineers needed

1. The flow of engineers and scientists who are competent to advance and administer the scientific, technological, and economic conservation of our water resources including, in particular, the control of water pollution, must be increased promptly by recruitment and training of basically qualified personnel at two levels: (1) the professional or predoctorate level, and (2) the post-doctorate level.

There are about 5,500 practicing sanitary engineers, of whom about two-thirds are engaged in the development and control of water resources. It is estimated that about 280 newly trained men are needed yearly to maintain present strength. This estimate is based on an assumed 5 percent loss per annum by retirement, death, or defection. About 100 additional men are needed annually to keep pace with the requirements of population growth, and 350 are wanted as soon as possible to ensure the accomplishment of urgently required technological advances. This implies doubling the professional population in 12 years and doing this in the face of growing competition for prospective scientific talent.

Work in this field demands, for the most part, training to the master's and doctorate level. The current output of sanitary engineers is about 300, of whom only about 130 have earned a master's degree and fewer than ten a doctorate. About 25 percent of these advanced students are trainees from foreign countries, leaving about 100 with significant education in depth for employment in the sanitary engineering fields in the United States. Obviously, this is too few for even current operations.

The universities of the nation award 60,000 master's degrees per year. Of these, 5,400 are in engineering and 17,000 in the physical and biological sciences. Therefore, sanitary engineering is losing out badly in competition for professional talent. At the doctorate level the situation is even more disturbing. Of the 300-odd doctorates awarded annually in science and engineering, less than 10 percent have been in sanitary engineering.

Data are lacking on the existing numbers of qualified chemists, biologists, economists, political scientists in the area of water resource development and conservation. However, both quantitative and qualitative estimates point to deficiencies that are at least proportional to, if not greater than, those in the engineering group.

The manpower needs for research are particularly acute. If research is expanded to an estimated requirement of $20 million by 1970 and if $20,000 will sustain one investigator for one year, about 1,000 investigators will have to work in this field. If 40 percent of these are to be engineers and 60 percent basic scientists, educational institutions will have to produce 400 sanitary engineers and 600 basic scientists with academic training that qualifies them for research. The current output of only six to ten doctorates in all branches of sanitary engineering is far short of meeting the need, and the competition for basic scientists is so great that a determined effort must be made to recruit needed numbers of research leaders in the respective fields related to water-quality control.

Can schools produce them?

2. The capacity of graduate schools or university departments of engineering and public health to produce a sufficient number of engineers and scientists who are able to deal effectively with the mounting problems of water resource control must be enlarged by support of staff, student body, and teaching and research facilities, as well as by grants-in-aid of research. Interdisciplinary research should be encouraged in particular. Because the use of personnel and the application of research lie in the public domain, the Federal government must be expected to assume a substantial portion of the required financial burden.

A solid look at our graduate schools shows that they are not too well prepared for such a load. Sixty-eight schools report the availability of graduate training in sanitary engineering. Of these, 36 offer training beyond the M.S. degree. Only 15 have averaged three or more M.S. and Ph.D. degrees per year since 1954. An additional 17 have averaged at least one but less than three per year. Eighteen of the schools have not granted any such degrees during this entire period. This is neither a balanced nor efficient organization in a nationally vital area.

The following deficiencies in capacity for research and training are estimated to exist:

(a) A 38 percent increase in teaching staff, and operation at optimum

and Training Needs Appraised

level of enrollment, will provide less than half the expected annual requirements for personnel trained at the graduate level.

(b) The expectation of an increased requirement of nearly twice the present research activity is dependent upon acquiring both the added personnel for teaching and the full-time research staff, or a total staff of 144.

(c) To provide the desired capacity for training and research will necessitate the addition of nearly 500 qualified persons for teaching and research.

More research needed

3. The flow of research findings on the water environment must be increased and intensified in depth as well as breadth.

Fundamental researches are needed in many aspects of water pollution control, including determination of the limits to which receiving bodies of water and biological as well as other treatment units can be safely loaded for the disposal of increasingly complex waste materials; identification of the role of water as a carrier of viral diseases, such as infectious hepatitis; and studies of long-range chronic effects of trace contaminants in water.

We need to increase our research efforts on the behavior and fate of newly introduced organic contaminants; and newly recognized viruses. We need to develop more effective means of removing pollutants from water in municipal and industrial water treatment plants; more effective process controls of industrial waste discharges; better recovery or utilization of industrial process wastes; and more sophisticated industrial waste treatment processes.

Water supply and pollution trends show that one of the most pressing problems in water quality management is the development of new treatment processes that will remove more of the contamination from municipal waste waters than present methods are able to do. Currently, large quantities of water must be made available to dilute and transport the residual wastes after treatment. When this water is not available, serious pollution hazards may result.

To discover and develop the required technologies will demand a major coordinated research program utilizing the best minds in the country and attracting physicists; physical, organic and bio-chemists; toxicologists; hydrologists; economists; geographers, and anthropologists who have not up to now been seriously engaged in water pollution research.

Treatment-plant personnel needed

4. The flow of treatment-plant operating personnel as well as engineers and scientists working in the wider field of water supply and water pollution control must be increased and their training broadened.

Two types of training are generally available. First, in-plant training of operating personnel for water and waste-water treatment works. This should be a requirement of all municipal sewage treatment works, particularly of those benefiting from federal aid. Second, academic training of such personnel. This is available largely through short-course programs and conferences in universities and colleges. This training is most desirable. However, the means and resources are quite limited in comparison with the number of technicians that will be required within the next 15 years for pollution control.

Multi-discipline approach

5. The field of water supply and pollution control has become so complex that we must think more generally than in the past, of a multi-disciplinary approach to the solution of developing problems. This implies the introduction of representatives of many disciplines including economists and political scientists, as well as applied mathematicians and physicists to this field and the creation of requisite institutes or centers for environmental health research at which needed personnel can be brought together.

Rapid changes and increasing complexity characterize our social and industrial growth. Research for the solution of today's problems calls for the group attention of scientists from the physical and biological sciences, sanitary engineering, applied mathematics and physics, and economics and political science. The making of headway is hampered by lack of communication with representatives of these areas. Unless a challenging program can be developed to encourage increased multi-disciplinary attention to research in this area, we must be apprehensive of our ability to cope with environmental health problems that the technological advancements of the next several decades bring.

Sample problems are: operations research or systems analysis of water resources developments including water quality control; integration of water purification and waste-treatment processes for maximum efficiency and economy; instrumentation for *in situ*, wide-scale, and longitudinal identification of pollution hazards and their control or prevention; automation of sampling and analysis of data; automatic computer control of treatment operations and warning systems for special hazards; and advanced methods of separation or destruction of solids in water. There are many others of like complexity and challenge that will face us in both the immediate and more distant future.

National support must be increased

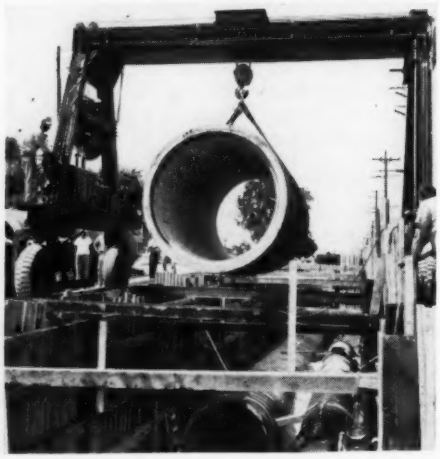
6. The total National support for research in water supply and water pollution control should be increased substantially.

In research, funds and facilities are needed to sustain investigators and to provide them with technical support and equipment. Only a small fraction of the Public Health Service funds devoted to medical research is being applied to research in water supply and water pollution control—currently less than 1 percent. A committee of Congress has estimated that the national support of needed research in all fields of science and engineering could and should increase to about $3 billion by 1970, and that the Federal Government should expect to contribute about two-thirds of this amount. If we apply the same growth factor to water supply and pollution control, we arrive at a national research budget of about $15 million, a major part of which will have to be provided by the Federal Government.

(More ASCE News on page 71)

Two 16-ft lengths of 108-in. reinforced concrete subaqueous pressure pipe are being lined up for welding into a 32-ft length on the contractor's dock. Pipe sections were later placed in 7,000-ft intake in Lake Michigan for Milwaukee's water supply.

A 32-ft length of 108-in. reinforced concrete subaqueous pressure pipe with strongback is being lowered for installation in Milwaukee intake. Low-pressure test bulkhead is in place on near end.



For Milwaukee's raw-water pumping main, 84-in. prestressed-concrete embedded-cylinder pipe is being laid in same ditch as 48-in. treated-water pipe of same type. Note hydraulically operated gantry used for all pipe laying operations.

Lock Joint-American plant makes concrete pipe near Lake Suche Peru, at an altitude of 15,000 ft. Pipe was used in a line to provide process water for copper mill in this mountainous area.

Prestressed-concrete embedded-cylinder pipe of 120-in. diameter is installed at Philadelphia's Torresdale water treatment plant. Method of sheeting, lowering and pulling pipe "home" is shown.

Concrete pressure pipe has many uses not only where installation and operating conditions are fairly straightforward but where layouts are complex and accurate tailoring of many special fittings is necessary. There has been a tendency on the part of some engineers and pipe users to regard concrete pipe as limited to long transmission lines and outfalls. The versatility of this pipe has been greatly increased in recent years as a result of the tendency to concentrate its manufacture in large, well equipped plants, capable of handling many different operations.

Five representative concrete pipeline projects have been chosen for mention here because of size, complexity, general interest or unusual character. They give an idea of the variety of uses to which this type of pipe is suited.

1. Reinforced-concrete subaqueous intake, 108-in., and prestressed-concrete transmission line, 84-in., for Milwaukee's water supply.
2. Reinforced-concrete transmission line, 42- and 36-in., high in the Peruvian Andes.
3. Prestressed-concrete process-water piping with complex fittings for an oil refinery in Delaware City, Del.
4. Prestressed-concrete outlet main, 120-in., for Philadelphia's Torresdale water treatment plant.
5. Israel's new prestressed-concrete pressure transmission line, 108-in., nearly 90 miles long.

Water intake and transmission lines

With the postwar upsurge of industry in Milwaukee, Wis., the demand on the water system began to outstrip the supply around 1955, making augmentation of the supply increasingly necessary. By 1957 plans were under way for a vast project, of which the initial phase would add 100 mgd to the existing 290 mgd in the city's system.

Concrete pressure pipe for major projects

J. A. SHAW, M. ASCE, Product Division Engineer, Lock Joint Pipe Company, East Orange, N. J.

This was estimated to be sufficient to meet the demand until 1970, after which the plan provides for a further 200 mgd. Milwaukee of course has an inexhaustible source of water in Lake Michigan. Under discussion here are the transmission lines to convey the raw water from the lake to the inland treatment plant.

These lines consist of an intake running 7,000 ft out into the lake and a 17,000-ft pumping transmission line from the lake-shore pumping station to the treatment plant. The intake line is composed of reinforced concrete subaqueous pipe of 108-in. diameter with rubber and steel joints, and wall thicknesses of 10 and 12½ in. The pipe was precast at a plant at South Beloit, Wis., and trucked to the contractor's dock in 16-ft lengths. Here twin pipe sections were welded together into 32-ft lengths to reduce the number of joints to be made subaqueously. The weight of each 32-ft length was 68 tons, requiring very substantial handling equipment. The welded joint is of the lap, or sleeve, type.

The rubber and steel joints made under water are provided with lugs and drawbolts to facilitate assembly. These had to be accurately positioned, both in lining up the two welded sections of pipe, and in lifting and lowering the complete 32-ft section. The bolts are at, or arranged symmetrically about, the spring line. The specifications called for the pipe to be installed in a trench, bedded on granular material, and backfilled with selected and excavated material. The pipe was placed originally on wooden sills and sandbags to establish accurate grade. Excavation of the 15-ft trench by clamshell, and laying of the 68-ton sections of pipe were carried out from two separate barges.

The pipe was lowered into the ditch and its bell was lined up with the spigot of the section previously laid. The rubber gasket was already in place on the latter. (Subaqueous procedure is, of course, the reverse of normal dry-trench installation, in which spigots are laid into bells.) The drawbolts were then inserted and the joint was pulled home by divers tightening the nuts, which were then backed off a few turns to retain joint flexibility, and the pipe was firmly bedded before backfilling.

The second part of the Milwaukee installation is the raw-water pumping main extending from the lake-shore pumping station to the treatment plant. This consists of 17,000 ft of pipe 84 in. in diameter, for which prestressed concrete embedded cylinder pipe was selected. The specified design operating pressure is 100 psi, with trench depths as great as 40 ft. This part of the project is mentioned here mainly to point out the successful use of two totally different applications of concrete pipe in the same system. The two types of pipe, although quite different, were manufactured in the same plant.

Pressure pipeline in Peru

In Toquepala, Peru, 167,000 ft of reinforced concrete pressure pipe was manufactured and installed by Lock Joint-American. This line, of 36-in. and 42-in. diameter, supplies process water to the flotation plant of the Southern Peru Copper Company's mines at Toquepala. In any normal location it would be considered a fairly straightforward application, but a few of the vital statistics will quickly indicate its unusual character. The water source is Lake Suche at an altitude of 15,000 ft; the lower terminal point of the concrete pipeline is at Cerro Pelado at 13,500 ft. Temperatures vary from as low as minus 15 deg F at night to as high as 80 deg F or more during the day. Needless to say, the location is isolated and rugged.

For economic reasons the pipe was manufactured on the spot at a plant established on the pipeline route about 8 miles from Lake Suche, virtually in the middle of nowhere. Every item of equipment and material had to be trucked over mountain roads from the coast. Although its distance was only 100 miles, it required a full day's drive over tortuous mountain roads and tracks.

At these altitudes the average person accustomed to living near the coast gasps for breath when merely walking across a room. After a stay of any length of time the result is generally nausea and loss of appetite. Even the smallest exertion requires the greatest effort. The effect of such conditions on the performance of the key supervisory personnel of a high-pressure construction project can well be imagined. The lack of oxygen not only affected the men but much of the equipment, which required special superchargers, without which it would have operated at very low efficiency, if at all.

The pipe, made by the roller suspension process, was of reinforced concrete design, with rubber and concrete-type joints. It was shipped to the ditch side by truck. It is of particular interest that this line, which is in the region of the recent earthquakes in southern Peru, has suffered no damage and has never been out of service.

Process-water piping at a refinery

Anyone who has seen the Tidewater Oil Company's two-hundred-million-dollar plant at Delaware City, Del., will appreciate the company's pride in one of the world's largest single-unit oil refineries. To an eye unfamiliar with the workings of a modern refinery, the plant appears as a maze of

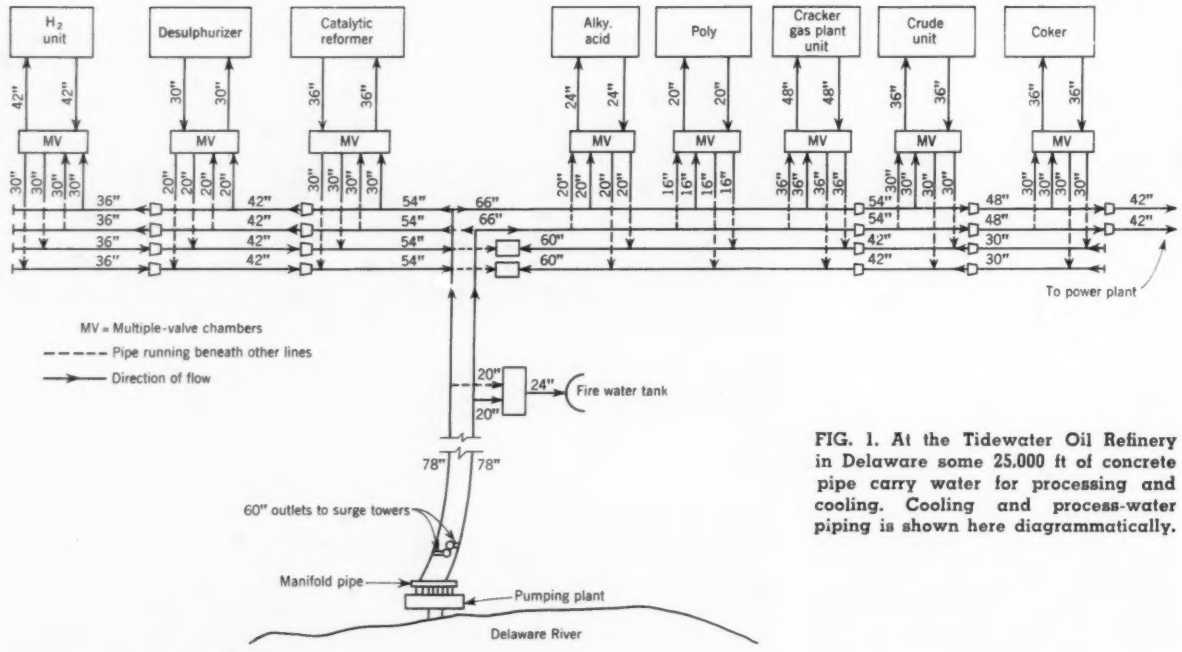


FIG. 1. At the Tidewater Oil Refinery in Delaware some 25,000 ft of concrete pipe carry water for processing and cooling. Cooling and process-water piping is shown here diagrammatically.

pipes, valves, pumps, pressure vessels, heat exchangers and other equipment rising from below ground, running along the ground, or towering to the height of a 25-story building. Literally millions of feet of small-diameter metal piping can be seen—all used to carry the various materials employed or treated in the process.

On a 90-mile pipeline job in Israel, engineers used side-boom tractor crane with additional counterweight and modified boom for carrying and yarding 108-in. pipe. Note swivel arm to hold pipe clear of boom during raising and lowering.

What most people do not realize is that many miles of concrete piping lie underground, carrying one of the most vital necessities of a refinery—water—for processing and cooling. See Fig. 1. While the lineal footage of concrete pipe is comparatively small, its importance in maintaining an uninterrupted water supply, both for processing and for fire protection, is considerable. This is an excellent example of the variety and complexity of which concrete pipe installations are capable. A brief description of the 25,000 lin ft of concrete pipe will give an idea of the complexity of the job and necessity for accuracy in manufacture and flexibility for field fitting.

The main supply is carried in twin 78-in. pump lines designed to operate independently of each other. Nine electrically driven pumps, a total of 18,000 hp, draw water from the Delaware River and pump it into a reinforced concrete pipe manifold of 78-in. diameter. This is bulkheaded in the center, and a 78-in. line leaves it at each end, so that one line can operate while the other is on standby. The 78-in. supply lines run into a grid of concrete pressure pipe from 30 to 66 in. in diameter, which in turn feeds into branch distribution piping of prestressed concrete from 16 in. through 48 in. in diameter.

The adaptability of concrete pressure pipe to the ramifications of plant piping can scarcely be more graphically demonstrated. Two 60-in. branches make accurate entry into a surge tank off each of the 78-in. supply lines. A 20-in. branch from each supply line enters a valve chamber further down the line, and each 78-in. pipeline makes union at its far end with 54-in., 60-in., and 66-in. pipes in the grid.

Branch piping ranging from 16 in. to 36 in. in diameter meets outlets in grid piping of eight different diameters while at the same time running under from one to three of the pipelines in the grid. There are eight multiple-valve chambers having four entries on one side and two exits on the other. The branch piping not only makes accurate entry into these structures and joins the valve fittings precisely, but in the restricted area of the chamber increases in diameter before exiting from the chamber to run into the processing unit it serves.

Largest prestressed-concrete embedded-cylinder pipe

Much material has already been published on the construction of the giant new Torresdale filter plant for the City of Philadelphia, on the banks of the Delaware. It is mentioned here because the 120-in. outlet line is believed to be the largest-diameter prestressed-concrete embedded-cylinder pipe ever built. The very excellent installation job done by the contractor is described in the April 1959 issue of *Construction Methods and Equipment*.

The use of a prestressed pipe in this

application is interesting. The operating head actually is relatively small, of the order of 50 ft, but the external load due to cover is considerable, since the trench depth is 26 ft. Because of the induced compression in the concrete core due to prestressing, this type of pipe has very considerable resistance to external loads, and its use in this case resulted in an economical design, suitable for resisting the combination of internal pressure and external load.

Such a large pipe, because of its size and weight alone, requires special handling and transportation equipment. The dimensions of a wye piece were such that it had to be transported in two pieces and assembled at the job site.

Israel's 108-in. transmission line

For several years the Israelis have been producing prestressed concrete cylinder pipe in one of the largest pipe manufacturing plants in the world. Also, their latest pipeline ranks as one of the largest and most ambitious projects of its kind in the world. It consists of nearly 90 miles of 108-in. prestressed-concrete embedded-cylinder pipe, subjected to pressures that vary from about 40 to 120 meters (about 130 to 395 ft) of head. The plan is to carry the waters of the Jordan River in the north to the Negev Desert in the south. By this means the desert is being effectively transformed into a fertile area.

The engineers responsible for planning the scheme conducted one of the most complete and thorough economic and technical investigations ever made of every available type of pipe. They wanted a pipeline that would literally "last forever," and initial expense was to some extent a secondary consideration. As a result of their investigations they came to the conclusion that prestressed concrete embedded cylinder pipe was the type best suited to their needs.

There are some novel features in the design of details on this line, partly because of the desire for permanence, and partly because of the ever present possibility of sabotage. Most essential fittings are duplicated, and vulnerable items such as blow-offs and air valves are encased in concrete, or are in chambers with limited access, and concealment is provided whenever possible. These people are past masters at improvisation in adapting surplus war supplies on standard equipment to their special needs, often with components from the junk yard. A typical example of one of these modifications is shown in an accompanying photograph.

Environment in exemplary engineering offices

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Office of Technical Controls, Department of City Planning, New York, N. Y.

It is the function of the ASCE Committee on Employment Conditions to study the compensation of the civil engineer. The Committee prepares a biennial salary survey in odd years, together with a semi-annual report on national changes in salary scales, published monthly in CIVIL ENGINEERING.

It is obvious that the returns from employment involve compensatory elements other than salary. Therefore the Committee in its 1959 Salary Survey included questions on fringe benefits. These were dealt with in part by Oscar S. Bray, F. ASCE, in his article, "An Examination of Civil Engineers' Compensation" (CIVIL ENGINEERING, November 1960, p. 41).

The Committee, in its deliberations on the employment of engineers, has also given attention to working conditions in engineering offices, which have an important bearing on employee satisfactions. It was felt that an examination of factors considered important in this connection would prove extremely helpful both to the employer of engineers and to the engineer employee.

In consequence, the Committee compiled a list of organizations known from the personal experience of its members to have excellent personnel policies and prepared a series of questions designed to disclose the relevant factors essential to the best working environment. To obtain a complete background it was necessary to include questions on fringe benefits as well as on office practices of concern to the employee. The organizations selected were known by the Committee to be willing to give usable information, and the inquiries were conducted in person and by mail.

Four categories of employers were queried: large private firms (12); small private firms (16); large public agencies (10); and small public agencies (12). Organizations with a staff of over 100 engineering employees were classified as "large," and those with fewer than 100, as "small."

Admittedly such sampling has its limitations, but it was felt that these limitations were overcome to some extent in this case by the factor of selection and that the survey would reveal prevailing employment practices as well as their relative importance in the different areas of employment.

Question 1. Do you encourage state registration as professional engineers? If so, how?

The replies indicate that registration is encouraged to a high degree in all four fields of employment.

In private employment, key personnel are required to obtain licenses. Often state fees are paid by the employer. Expenses for out-of-state licenses required for the firm's business are almost invariably so paid. Private firms encourage licensing as proof of professional maturity. A license leads to professional recognition, increased responsibility, advancement and better pay. Obviously a high ratio of licensed personnel is a distinct advantage to the private employer.

In large public agencies, the license is a primary requisite for positions of professional responsibility to which rewards of better pay and advancement are attached. Except in a few instances, financial aid is lacking, but time off and special coaching are quite common. In the small agencies the urge towards registration is just as strong although the license requirement may be omitted in position qualifications, possibly to facilitate recruitment.

Question 2. To what extent do you allow time off for participation in outside technical and professional activities?

Broadly stated, participation of personnel in technical and professional activity is stimulated and even requested. Preparation of papers in the field of activity in which the organization is involved is encouraged as well as attendance at seminars, professional conferences, committee work in technical fields, and participation in the activities of technical societies. Clerical and stenographic aid is supplied. This attitude results from a genuine interest in the profession although the organizations are thoroughly cognizant of reflected credit.

Opportunities for assistance in the way of time off and paid expenses appear to be greater with a large private firm. Although the emphasis on participation by the employees of a small private firm is indicated as substantially greater, there appears to be a more severe limitation on time off and payment of expenses. Large firms tend to budget funds for such purposes and often have established procedures with regard to such participation, whereas in the small firm such allocations are decided on an individual basis.

In the case of the large public agencies a considerable latitude in time is permitted, with considerable accommodation in expenses where the interests of the agency are definitely involved. The small public agencies exhibit the same interest as the larger agencies, although funds are somewhat circumscribed and concern is felt as to the effect on the work load, staff and budgetary limitations.

Question 3. Do you provide and maintain a technical library that is available for general reference by employees?

Private organizations exhibit much interest in the provision of such facilities. Of course the larger firms are able to provide a greater variety of library services. It appears that once the basic expenditures for a library have been made, the annual outlay for the maintenance of an adequate basic working library is well within reach of the majority of the private firms.

Large public agencies show an equal interest in the provision of technical libraries and allow much latitude in their use. They also rely to a large extent on public and other libraries and have frequently worked out exchange agreements. Considerable reliance is placed on basic departmental libraries and, in a number of instances, a most complete library service is afforded, with bibliographies, abstracts and routing of material. In the small public agencies it is difficult to assess the facilities afforded although these organizations would appear to depend largely on basic departmental libraries supplemented by technical publications.

Question 4. Do you have provisions for retirement or a profit sharing plan? Do your employees contribute to the plan?

With respect to the private firms it is assumed that the basic Social Security provisions apply. Public agencies may elect to provide Social Security coverage as a retirement plan but our concern relates to provisions over and above this.

Of the large private firms, seven out of twelve had some form of retirement plan of which four involved employee contributions. Five had profit-sharing or bonus plans, in some instances in conjunction with retirement plans. Three had neither bonus nor retirement plans, although in two of the three, retirement plans were under consideration. From the information given it was not possible to evaluate the retirement, bonus or profit-sharing plans or to equate the bonus or profit-sharing plans with retirement plans.

Four out of 16 of the small private firms had retirement plans. Six had bonus or profit-sharing plans, in two instances limited to partners, associates or supervisory employees. In two of the four organizations having a retirement plan there was a bonus plan as well. In three of the four retirement plans employee contributions were involved.

In private employ the returns indicated some hesitancy in embarking on retirement plans because of, first, the form of organization, and second, the relatively short length of time the organization had been in existence.

One firm's approach to the retirement question is worthy of note. It involved contributions both by the firm and by the employee to an annuity policy, for which, after a specified period, the employee would be permitted to pick up the coverage if he changed employment.

It would seem that if this type of policy could be adapted to the general field of engineering employment, and could gain general acceptance there, it would enable the small and the newer firms to participate and would permit the employee to carry his policy from job to job. As indicated by Mr. Bray in his article, about 17 percent of the employers' payroll is allocated to nonsalary benefits. It is obvious that some of these benefits are of relatively less importance to the employee than adequate retirement provisions.

Among the public agencies, 21 out of 22 had retirement provisions to which the employee contributed largely on a fifty-fifty basis. In some instances, insurance provisions were included, in others Social Security was made a part of a coordinated plan. In others Social Security was available as a supplemental retirement fund.

Along with such plans of the public agencies go regulations for minimum length of service and mandatory retirement ages. Formulas based on length of service determine retirement pay. In only one instance was retirement in public agencies limited to federal Social Security.

Question 5. Do you provide a group health insurance plan? Do your employees contribute?

The ordinary forms of health insurance such as Blue Cross and Blue Shield are practically universal in private employ. Employee contributions ran high although in about half of the smaller firms the employer assumed the total cost. Additional coverage for the family plan is generally paid for by the employee. In only a few instances is complete medical coverage available and often supplementary insurance is provided.

In the public agencies there is some form of health insurance, in almost all instances based on contributions, generally by both employer and employee. In the larger public agencies there are diverse forms of insurance protection. In the smaller agencies the form of protection is not stated. Except in a few instances, complete medical coverage is not provided, and the extra cost of family protection is paid for by the employee.

Question 6. What is your vacation and sick leave policy?

Among the large private firms two weeks is the general rule for vacations after one year of service and three weeks after 10 to 15 years. In the small private firms two-week vacations predominate, three weeks being granted in a minority of instances and only after long service.

In the large public agencies there is a sliding scale for vacations and it is based on length of service: two weeks for under five years; three weeks for 5 to 10 years; and in a number of cases, four weeks after 10 to 15 years. In the small public agency, two-week vacations predominate, although in about one-third of the samples three weeks is obtainable after 5, 10 or 15 years of service.

Sick leave in the private firms is not normally based on a formula. Where rulings have been established, they range from 5 to 12 days a year. Sick leave for longer illnesses is largely discretionary with department heads. Normally sick leave is not cumulative and, with one exception, was paid for on a full-time basis.

Public agencies tend to rely on formulas ranging from 1 to 1½ days per month, largely cumulative in the large agencies and less so in the small ones. Illness is paid for on a full-time basis, and in the small agency the matter of sick leave is largely discretionary with department heads. In several instances elaborate schedules of full, three-quarter, and half pay have been worked out in terms of tenure. Sick leave may accumulate up to 50, 90, or 180 days or may be without limit. In one instance unused leave up to 90 days was paid for upon severance.

Question 7. How often do you review salary scales?

In the private firms, salary scales are reviewed twice annually in the majority of cases and once yearly in the remainder. In the higher brackets a yearly review appears to be the prevailing practice. Reference was made to ASCE salary data a significant number of times.

Public agencies review annually for budgetary, personnel or legislative purposes. In a considerable number of instances increment schedules are in effect. In others established schedules for employee classifications are reviewed annually or biannually and in others prevailing rate situations require periodic review.

Question 8. Does your physical plant provide an attractive environment?

A considerable number of non-informative "yes" answers were received to this question. However certain factors were stressed. The private firms lead in air conditioning (12 out of 28). Good lighting and modern buildings were mentioned in 12 out of the total of 50 samples of both private firms and public agencies.

Adequate space and private offices were points of comment, particularly with the small private firm. A general rating of good was noted for 23 out of the 28 private firms considered and for 14 out of the 22 public agencies. Other elements such as rest rooms, background music, coffee bars, off-street parking, cleanliness, decor and sound-proofing received random mention.

Question 9. To what extent do you contribute time off and/or financial aid to further employees' education?

Educational objectives often fall into distinct categories:

1. In-training courses fitting the employee to the organization;
2. Special technical training courses and seminars directly related to organization requirements; and
3. General studies designed for the education of the individual with only indirect benefit to the organization.

In general it may be said that in the larger organizations, both public and private, emphasis was laid on in-training courses and on the utility of the course of study to the organization. Considerable latitude in time and expense is allotted in such instances.

The large organizations, however, encouraged to a high degree advanced courses of study for the individual where only indirect benefit to the organization resulted. In some instances scholarships were given, and tuition and books were paid for. Such assistance was given primarily for study at night or on the employee's own time.

With the smaller organizations both public and private, it appears possible to make concessions based on individual circumstances to an extent that would be impracticable in larger organizations.

In the small private firm educational courses favoring direct organizational benefit were stressed, and assistance was given by time off and payment of fees. General studies were encouraged by a rearrangement of working schedules or summer employment but little time off and slight financial help were granted.

In the small public agency, much less emphasis was placed on educational programs. Where there were such programs, they were largely related to agency benefit, with the granting of time off and tuition. Minimum interest was shown in furthering general studies primarily of benefit to the individual. In rare instances limited time off was given, and financial aid was almost non-existent.

Question 10. To what extent do you keep your employees informed as to your organization's management policies and plans for the future?

In the large private firm such information appears to be disseminated predominantly through the medium of magazines or news letters and secondarily through the supervisory staff. In several instances there was little or no organized effort to transmit such information to the employee. In general, with notable exceptions, little direct contact between management and employee was indicated.

The large public agencies, in general, make broad and effective use of all means of communications, bulletins, orders, house organs, and direct notification, together with frequent supervisory and general staff meetings. Thus there appears to be minimum utilization of the supervisor as a source of employee information in such agencies.

In the small public agencies and small private firms much reliance is placed on personal contact and on staff and supervisory staff meetings. Formal or organized communications are deemed unnecessary or inadvisable by the small private firms. The small public agencies, however, appear to utilize organized communications to a considerable extent.

In general it is evident that in several of the fields of employment much greater advantage could be taken of the many and diversified means of providing information to employees with an attendant increase in personnel interest in the organization.

Question 11. What other policies do you have that contribute to better employment conditions?

This question served as a catch-all for many diverse elements of employment benefits. Many answers cited monetary benefits and insurance features that probably should have been included in the answer to Question 4 or 5. The remainder related to social activities and personnel practices designed to provide employee satisfaction and minimize employee turnover. Others emphasized opportunities for employee advancement inherent in their particular fields.

The private firms, both large and small, and the large public agencies take the lead in efforts to maintain employee interest. Replies from the small public agencies, with a few notable exceptions, indicate limited application of personnel practices intended to stimulate group and individual interest.

Rapid transit system proposed for Los Angeles would provide high-speed, electric-powered transit vehicles running on rubber tires on concrete tracks. Artist's rendering superimposed on a photograph shows how the overhead structure would carry two tracks on a single row of columns in the middle of the street.

Rapid transit for Los Angeles

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Los Angeles, the city of automobiles, is now taking steps to balance its transportation system with a modern rapid transit system. This city, which is renowned for the quality and complexity of its freeways, is discovering that freeways alone cannot solve its problem. Fully two-thirds of what is known as the "central city area" is now unproductively devoted to freeways, streets and off-street parking. The key needed to change Los Angeles and the adjacent sprawling complex of communities into a great city is rapid transit.

In 1956 the Los Angeles Metropolitan Transit Authority was given real power, by a legislative amendment, to enable it to acquire local bus companies and to explore means of providing rapid transit service throughout the whole metropolitan area.

The Authority then took the first step toward a comprehensive program to determine the feasibility of providing a mass rapid transit system. This first step involved surveys of movements of people throughout the area with sufficient sampling to permit a compilation of trip origin and destination data. Carried out by the New York firm of Coverdale & Colpitts, the study showed a volume of 11,000,000 trips on an average weekday, and resulted in the definition of travel desire lines.

These desire lines showed a concentration of movement in 12 corridors of traffic flow and recommendations were made for priority consideration for the following four corridors: (1) Wilshire Corridor, extending from the Los Angeles central city to Santa Monica; (2) Reseda Corridor, from the San Fernando Valley via Cahuenga Pass to the Wilshire Corridor; (3) San Bernardino Corridor, from the central city eastward to Covina; and (4) the Long Beach Corridor, extending southward from the central city to Long Beach.

These initial corridors formed the basis for the next step in the rapid transit program, which called for the determination of the type of system to be used, specific alignments and station locations within each corridor, and a preliminary estimate of cost. The Authority retained Daniel, Mann, Johnson, & Mendenhall to carry out the necessary engineering evaluations and investigations.

In view of the mounting traffic congestion, the program was shifted into an accelerated schedule requiring an initial evaluation report within 90 days and a final report within seven months. The investigation was accordingly divided into two phases: (1) a broad evaluation of possible transit systems and alignments and the selection of a limited number of alternates for detailed study; and (2) a comparative analysis and definitive engineering of the several alternates so that costs and other advantages and disadvantages could be compared.

Transit equipment

An evaluation of rapid transit equipment and system configurations was one of the principal efforts during the initial phase of the Rapid Transit Program. The first step in the process involved the development of basic criteria for a mass rapid transit system for Los Angeles. A set of minimum requirements covering a broad range of functional factors was used effectively in the initial screening of transit system proposals.

It was determined from preliminary planning studies that the transit equipment must be capable of speeds up to 80 mph and average speeds of 35 to 40 mph, depending on the spacing of stations and the duration of station stops. These speeds are 25 percent better than the freeway peak-hour speeds. The system further was required to provide for 30,000 passengers per hour in order to have adequate capacity. Factors of convenience, comfort, safety and esthetics were added to complete the transit criteria.

Screening of systems started with a

series of hearings and presentations in which various manufacturers, inventors and proponents were encouraged to submit their ideas. Some fifty individuals or firms were heard, and almost every conceivable form of transportation, ranging from helicopters to moving sidewalks, was considered. Evaluation of these systems resulted in three types being recommended for detailed study and comparative analysis—the conventional dual-track system; the supported monobeam, commonly called the saddlebag monorail; and the split-rail symmetrical suspended monobeam system.

Systems analyzed

In carrying out a detailed comparative analysis of the three systems, it was necessary to make a field survey of similar existing facilities in order to get up-to-date information on operation and development. Investigations were made of selected installations in North America and Europe to study switching mechanisms, power, propulsion, guidance and safety features. Preliminary designs were prepared for the three systems, adapting them to Los Angeles requirements and putting them on a comparable basis.

Special investigations were carried out to determine the feasibility of using rubber tires on the equipment since sustained grades of up to 6 percent would be encountered along the line over Cahuenga Pass in the Reseda Corridor and at interchanges. Noise was also deemed a critical factor. These studies showed that rubber-tired vehicles would be able to negotiate the steep grades with ease, would emit 50 percent less noise than steel-wheeled vehicles, and would permit a substantial saving in weight over conventional transit cars.

In making the actual comparison among the three systems, both functional and cost factors were considered. The results showed that any one of the three systems could be applied to Los Angeles. However, the cost analysis indicated that the supported dual-track system was the least expensive. Even with modifications to permit the use of rubber tires and special safety devices, it still represented the most advanced stage of development based on the extensive operation of similar vehicles in the Paris subways and on the French National Railways.

Metro system recommended

The system recommended is called the Metro system to denote its applicability to metropolitan transit service. It is believed that the trains on this system would be among the fastest and lightest in weight of any in operation in the United States. The system would be of ultramodern design. The cars would run on rubber tires but would have light-weight steel auxiliary wheels for additional safety and for switching on conventional rail switches. Guidance would be provided by horizontal wheels riding on center guide rails. Positive insurance against derailment is provided by an uplift stop that rides between uplift channels incorporated into the center guide rails.

The cars would be 54 ft long, 10 ft wide and 12 ft high from top of track to top of car. Of lightweight design, they would utilize aircraft manufacturing techniques. They would be air conditioned and capable of seating 54 passengers and up to 66 standees without overcrowding, and would be operated in trains of from two to six. Easy access in and out of cars is provided by three sets of double doors on each side of each car. This will permit either center or side platform loading. The cars have end doors for emergency use.

The trains would be capable of speeds up to 80 mph and accelerations up to 3.5 mph per sec. A direct-current traction power of 600 volts would be used with four 125-hp electric motors per car. Power would be supplied to trains from a contact rail with a negative return, which would not be

Proposed routes for the Los Angeles Metro System include initial four-corridor routing (solid lines) and later extensions (dashed lines).

Metro cars would be capable of speeds up to 80 mph and would be air conditioned and automatically controlled.

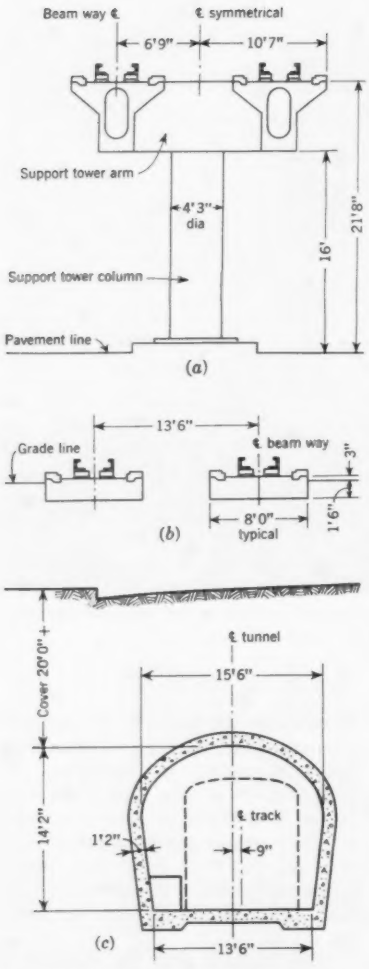


FIG. 1. Way structures proposed for the Metro system by consultants include: (a) overhead structure which would feature reinforced concrete construction and spans of 110 ft; (b) beam-way for operation at grade in railroad or other existing grade-separated right-of-way; and (c) subway, which would be constructed by tunneling between stations, with cut-and-cover methods used for underground station construction.

grounded except at substations. Dynamic braking would be used in conjunction with disc brakes, which would permit emergency deceleration amounting to 4.5 mph per sec.

Automatic control

An analysis showed that for high-speed operation a system of automatic controls would be necessary for completely safe operation. Accordingly, a fail-safe automated system was designed incorporating central train control with a programmer, central computer, wayside control unit and train control unit.

While the system is capable of unattended operation, one attendant will be carried in each train for passenger control and increased safety. With this system, headways of less than 90 sec can be maintained. With stations spaced at one-mile intervals and 20-sec station stops, average speeds of from 35 to 40 mph, including station stops, can be maintained. This is approximately double the average current speeds on rapid-transit systems in the United States.

Way structures

The necessity for costly way structures arises from the fundamental need to provide a grade-separated transit system. This is the only way a truly *rapid* transit system can be obtained. A transit system, unlike freeways, is limited in the choice of routes. Since it must provide revenue based on service, it must follow routes along which maximum patronage can be assured, and therefore must penetrate areas of business, industrial, commercial, and other high-density land uses. Except for special cases where there are existing railroad rights-of-way in several of the corridors, it was found that the existing street system is generally the most logical location for rapid transit.

The choice, then, is whether to build the system under the streets—a subway system—or above them—an overhead system. Typical structure diagrams for subway and overhead operation, as well as for operation at grade, are shown in Fig. 1. Because of its enabling legislation and financing limitations, the Los Angeles Transit Authority has sought the type that is most economical to construct and operate. This makes the cost comparison a most important factor.

In order to make a comparison of costs, preliminary designs were prepared to serve as a basis for comparative estimates. Special investigations were undertaken to determine geology and subsurface conditions, and tunnel construction techniques were analyzed to determine the method best adapted to Los Angeles conditions. It was found that the cost of subways would be from two to three times that of overhead facilities and that overhead facilities would offer important advantages over subways from the standpoints of construction time and street interference.

In view of the requirements of the Authority, a predominately overhead system was recommended as being the lowest in cost. The Authority is vitally concerned with the many effects of the transit system on the communities through which it passes. It must also provide a system with maximum appeal to the user. These criteria indicated the desirability of quiet equipment that would run on a graceful overhead structure except where it could be operated at grade.

A short section of tunnel was incorporated in the plan in an area where city streets are not suitably oriented and where it is more economical to build underground than to acquire private right-of-way.

The overhead way structures would consist of two reinforced concrete beams supported at intervals of 110 ft by a single round concrete column. Stations of the center-platform type were chosen, with platforms 448 ft long in the central business district to accommodate the anticipated future train length of eight cars. Outlying stations will initially have platforms 336 ft long and will be designed to permit future expansion to 448 ft. The stations will be provided with means of automated fare collection and will be architecturally designed to be both functional and esthetically pleasing. Storage and maintenance facilities will also be included in the plan, together with buildings for central dispatching and train control.

System planning

Before proceeding with detailed route locations, a long-range plan was worked out to insure that initial transit installations would be compatible with the future growth of the city and transit system. An analysis was made to determine how to provide transportation into each of the major passenger generating areas without duplicating

TABLE I. Cost estimate for 74.9-mile four-corridor system

Structure and road bed	$155,900,000
Stations	$ 41,800,000
Electrification	$ 51,900,000
Control and communication	$ 20,600,000
Utility relocation	$ 18,000,000
Yards and shops	$ 7,600,000
Secondary distribution system	$ 20,800,000
Land acquisition and right-of-way	$ 26,200,000
Rolling stock	$ 75,900,000
Total (1960) cost	$418,700,000
Administrative and professional (estimated at 10%)	$ 41,900,000
(To include engineering, surveying, subsurface explorations, construction supervision, testing and inspection, management and administrative and operation start-up)	
Plus reserve for contingency, at 15%	$ 69,100,000
Total system cost (1960)	$529,700,000

or overlapping service. This investigation resulted in a long-range development that consists of eight corridors. Initial development calls for four corridors in a system 75 miles long with provision for expansion to a 150-mile eight-corridor system. Major "park'n ride" stations were proposed in each corridor to facilitate the collection of passengers. The stations within the corridors were, where possible, coordinated with the Authority's bus lines to serve as feeders and distributors.

The Los Angeles central city, by virtue of its position at the junction of the corridors, is the heart of the transit system. The planning analysis of service to and through the central city showed the necessity for providing both main-line service and supplementary secondary passenger distribution within the central area in order to secure the needed station coverage. Initially, the secondary distribution could be provided by a system of buses operating on exclusive lanes. Ultimately, a fixed, grade-separated lightweight transit system is envisioned to distribute passengers and relieve sidewalk congestion. The system would operate at 15 mph, and would have stations spaced about 600 ft apart. The secondary system would be designed to connect conveniently with the primary main-line system.

System cost

The recommended four-corridor, 74.9-mile system was estimated to cost $529,700,000. See Table I. This system would include 2.3 miles of tunnel, 21.6 miles of line at grade, and 51.0 miles of overhead line.

The Transit Authority has taken the report under advisement and is seeking public reactions to the recommendations on route and equipment contained in the report. As a further step, the Authority has asked Coverdale & Colpitts to do further work in estimating potential revenues from the recommended system. The Authority is at present seeking changes in its enabling legislation to clarify its powers so that it can finance and carry out whatever program is chosen—by means of revenue bonds.

C. M. Gilliss, Aff. ASCE, is executive director of the Transit Authority and E. R. Gerlach is chief engineer. I. F. Mendenhall, F. ASCE, president of Daniel, Mann, Johnson, & Mendenhall, was in charge of the work, which was carried out under the direction of David R. Miller, M. ASCE, project manager. The project engineers were P. M. Linscott, M. ASCE, planning; W. D. McEwen, M. ASCE, facilities; R. C. Westerfeld, systems; and F. W. Kohout, equipment.

GOOD INDUSTRIAL FLOORS:

What it takes to get them and why

C. FRED YTTERBERG, Aff. ASCE, President, Kalman Floor Company, New York, N. Y.

Part 1: Monolithic concrete floors

Floors for industrial plants are not easy or simple to install. Apparently the truth of this statement is being widely realized for it is a fact that such floors are being recognized as trouble-makers of the first order.

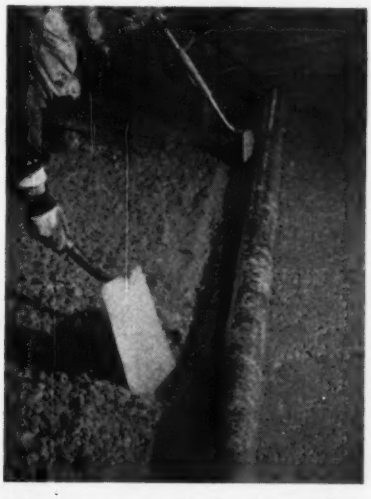
Two surveys point up this fact. One conducted by *Architectural Record* two years ago showed that 61 percent of industrial floors were troublesome. Last year the American Institute of Plant Engineers (AIPE) made a survey of its members who operate plants constructed within the past 10 years. The AIPE wanted to find out what items of the physical plant cause the most trouble. Floors were cited as the third most troublesome item. (Heating and ventilating systems were first and roofs were second.)

One reason for this pattern of industrial floor trouble is that such floors are subjected to more severe use than any other building element. This use comes principally from materials handling equipment, heavy storage loads, and spillage and drippage. Another reason is that floor surfaces are tied into most other structural elements. If these elements are improperly designed or installed, they can create stresses, which usually are relieved only by excessive cracking of the floor. A third reason is that many floors are inadequate for the use to which they are put because of a misunderstanding about what service can be expected from various floors.

Types of industrial floors

Two types of concrete industrial floors make up by far the majority of today's installations. These are known as monolithic and topping. Monolithic floors are finished base slabs, although a stone wearing surface, such as a hard, tough basaltic or granitic rock may be incorporated into the matrix for extra wearing qualities. Monolithic floors are intended for light to medium duty. Toppings are separate courses about ¾ in. thick, installed on top of the base slab. Toppings are for heavy duty. Monolithic floors are usually made with 2,500- to 3,500-psi concrete; toppings can reach a strength of 8,000 to 10,000 psi if the proper installation procedure is used. This measure is important, for compressive strength is one of the best indicators of abrasion resistance.

A third type of floor—epoxy topping—holds great promise for areas subject to corrosion. This article is limited to monolithic floor construction techniques; later articles will dis-



After the concrete for the base slab is spread to grade, it is screeded to the line of the finished grade.

cuss concrete topping construction techniques and epoxy toppings. The reason for this order of presentation is that much of the service that a concrete or epoxy topping will give depends on how well the base slab has been installed. Monolithic floors are fundamentally base slabs. This article thus provides the necessary background for the two discussions on toppings.

These articles do not, of course, contain a complete step-by-step guide. The step-by-step method of presentation has been adopted only for the sake of clarity. But it is certain that if these, or equivalent procedures are not followed, top quality industrial floors will not be produced. Shortcuts or deviations must result in some diminution of quality.

Supervision—why it is necessary

The procedures outlined below are, obviously, complex ones, and they are points which all good engineers cover. But they must be carried out at the job site; for this reason skilled workmen who are trained to carry out detailed procedures, and supervision that is constant and experienced, are mandatory for successful installation. These points are valid for all types of floors. A good supervisor must be part diplomat, for he must deal with many people, and he must be part labor boss, for he must obtain maximum production without sacrifice of quality. Above all, he must understand industrial floors and all their ramifications, for conditions vary from job to job and it is up to the superintendent to recognize these conditions and to suggest modifications.

Monolithic floors

A monolithic floor preferably is installed after the heavy construction work is complete and the building is enclosed. Obviously this procedure is not always possible, but where possible it protects the floor from the elements and from use by heavy equipment, which is inevitable during construction. The following steps are those we have found necessary to produce a good monolithic floor. Some of these steps, obviously, are not the responsibility of the floor specialist contractor, but nonetheless they do affect the quality of the finished floor.

What is discussed here is an on-grade installation. The surface for a structural slab supported by the building frame will be attained in the same way.

1. Site selection. A high water table requires a special design to alleviate hydrostatic pressure. Mineral deposits, such as sulphur or coal, can adversely affect a concrete floor because fumes seeping from them will react with the cement or aggregate. Likewise, any variable underground air pressure can affect the floor if air is forced through the ground and through the slab before it has hardened.

2. Subgrade. A floor is no better than the base on which it is placed, because swelling or settlement will set up unforeseen pressures or weak spots. Also the subgrade must be even. If it is uneven, the slab will not be uniform in thickness, and when loaded it will crack in thin areas. Therefore the subgrade must be compact and level. Most state highway departments have standards for the compaction of highway subgrades and these should be used. On large jobs, grading and compaction should be done with road construction equipment.

If fill is required, it must be built up and thoroughly compacted in 6-in. layers. Any footing holes, pipe trenches, or irregularities in the natural grade must be filled in layers and tamped. Areas that cannot be reached by mechanical equipment, such as those adjacent to walls and columns, must be tamped by hand, or by hand-held power rammers, to the required density.

Fill must be uniform in character and free from large lumps, sod, stones, frozen chunks, or organic material, which might rot. For the best results and the greatest density, there is an optimum moisture content for each material. With proper moisture content, most soils (sandy soils are the general exception) will cling together when squeezed in the hand but will not be plastic or muddy. If the fill is too wet, it must be allowed to dry before rolling. For sandy fill, if there is any question as to the moisture content, more water should be added since an excess of water will not generally be harmful with this type of fill.

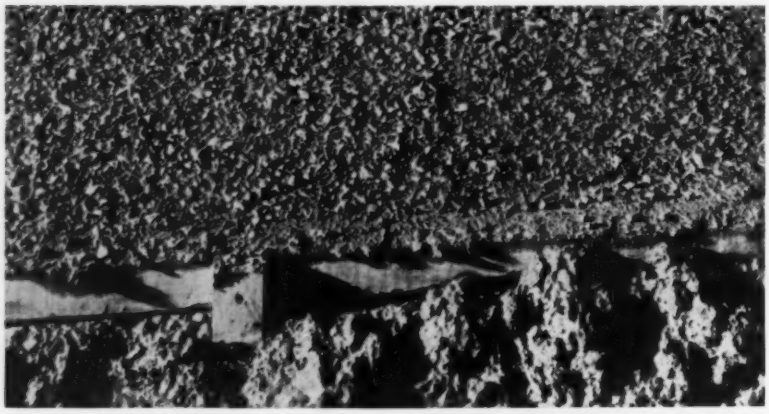
The subgrade must be moist when the concrete is placed. However, pools of water should not be formed and the subgrade should not be muddy or soft when the concrete is placed. Moisture in the soil prevents excessive loss of water from the concrete mix, which might adversely affect hydration. The use of a layer of polyethylene or waterproof kraft paper is effective and indicated in some instances to prevent loss of water from the slab.

3. Construction joints. The construction joint limits the area of a pour. It is outlined by bulkheads, which also serve as screed levels. The bulkheads must be strong enough to hold the plastic concrete without yielding because if yielding occurs the mix will become less dense at that point and strength will be lessened, which means that the strength at the joints will not be as great as it should be.

To get proper joint edges, bulkheads must have sharp, clean and square edges. Irregular, rough bulkheads cause irregular joints, which later show up in cracks and raveling. Bulkheads must be kept in place until the concrete is hard; they must be removed carefully to prevent damage to corners, edges, and keyways.

Construction joints may be strengthened by keys or dowels to transfer shear. If joints are keyed, the slab should be thickened to at least 8 in. and the lip above the key made at least 3 in. thick to prevent the lip from breaking off. In doweled joints, ¾-in. round smooth bars 18 in. long should be spaced 18 in. on centers. Half of the dowel should be greased, or sleeved, to permit slippage.

4. Contraction joints. Concrete shrinks when it hardens. (Inside a



Stone wearing surface is applied carefully for even distribution to every part of the surface. Rock penetrates and interlocks with the slab to a depth of from 1/8 to 5/16 in.

building expansion of the concrete slab is not ordinarily a problem and will not be considered here.) Although shrinkage can be decreased by several mix details, it will always occur. Contraction joints relieve the stresses caused by shrinkage and therefore reduce the number of surface cracks attributed to this cause. These joints do not guarantee a crack-free surface, but they do minimize these cracks. Contraction joints must be placed so that all the panels are nearly square. Unless the panels are approximately square, they will almost certainly crack across the narrow dimension. Contraction or construction joints should be placed on column lines, but if the column spacing exceeds 50 or 60 ft, intermediate joints should be provided.

A construction joint forms one type of contraction joint when so installed.

Another type of joint is formed by sawing into the slab to a depth of at least one-quarter of the slab thickness. Sawed joints are particularly effective when the slab cannot be poured in a checkerboard pattern and as a matter of fact are better in point of edge strength. A sawed contraction joint is very effective in transmitting shear across the joint because the section below the cut will crack unevenly in the slab. Sawed joints should be cut the day after the slab is finished in hot weather or within two or three days afterwards in colder weather. When severe drops in temperature are expected, cutting must be done as early as possible, before contraction causes uncontrolled cracking.

5. Settlement and expansion joints. The floor must not be tied into walls, columns and foundations in such a way as to impede independent movement of any of these members since these elements may settle or move at different rates. Otherwise the floor will be cracked by stresses developed by differential settlement or movement. At columns, joints should be located outside the line of the pier below the column; the joint should be circular or diamond-shaped around the column. Joints usually are filled with preformed mastic, ¼ in. or more thick, which permits expansion and vertical movement.

6. Concrete. Admixtures must not be used except in special cases. In our own operations we consider this point so important that admixtures cannot be used except on order of the regional manager. Air-entraining concrete produces a floor with a relatively weak surface and should never be used unless the floor will be exposed to the weather and to freeze-thaw cycles during use. Water-reducing agents can be used to improve workability if the slump is below 4 in. and if the agent does not contain calcium chloride. We feel that retarders should never be used for floor-slab concrete. Calcium chloride in amounts up to 2 percent by weight of cement can be used to secure more normal setting in extremely cold weather. A very complete discussion of the effect of admixtures can be found in ASTM Special Publication No. 226, "Symposium on Effect of Water Reducing Admixtures and Set Retarding Admixtures on Properties of Concrete."

Hard, well-graded aggregates tested for soundness should be used, but with only the minimum amount of fine aggregate to minimize shrinkage. For average slabs, a mix of about 3,000-lb compressive strength is desirable. Concrete of too great strength may result in greater shrinkage and cause cracks.

Slabs for industrial floors usually should be no less than 6 in. thick, and

Surface is leveled and worked again with a long-handled wood float, which "sets" the hard wearing surfacing in the firm grip of the concrete mass. Rock stays at the surface, where its wearing qualities resist heavy traffic and loads.

Troweling starts after water sheen has disappeared from the surface. Final troweling leaves the floor with a smooth, hard finish free from marks and blemishes. After thorough curing, the floor is treated with a sealer.

sometimes more, depending on the service. Also reinforcing becomes less important as more attention is paid to the subbase and the slab itself.

Slump must never be more than 4 in. and concrete should be placeable without accumulation of excess water on the surface. High-slump concrete contains an excess of water which causes shrinkage, cracking, and a weak surface.

However meticulous the control of mixing water, mixing time, and revolutions of mixing may be in the truck-mix operation, it is frequently necessary to adjust the slump before the mix is discharged. If water must be added for this purpose, it should be thoroughly incorporated by about 20 to 30 revolutions of the drum at mixing speed to assure uniformity of slump.

The method of discharging concrete from a transit-mix truck has a great effect on slump; indeed, the first and last buggy loads of concrete from a single truck can have radically different slumps. Unrestricted discharge at full drum speed, with a full discharge opening, is desirable when concrete can be discharged at the maximum rate. When the discharge rate must be less than maximum, as into buggies, it must be controlled by manipulating the drum speed, not by varying the discharge opening, since that practice induces segregation. Sometimes it is desirable to let the drum revolve several times in the mixing direction in the interval between discharging operations to keep the mix from segregating.

Also to avoid segregation, flat chutes should not be used unless the concrete is helped along by shovels or hoes; long chutes likewise should be avoided. The discharge chute should be near the ground and should be swung back and forth to avoid coning; and concrete should be deposited in the forms as nearly as possible in its final position. Hand rodding is often required in corners or in narrow forms. Spading of vertical surfaces is necessary to eliminate water and air pockets.

Concrete must be screeded off level. Concrete with a slump of 3 in. or less can be handled with a roller screed. Low-slump concrete can also be handled with a vibrating straight-edge. Better built screeds are necessary with a vibrating screed than with a roller screed.

7. Quick troweling. At this point the surface can be quickly leveled by mechanical means and then given a quick pass or two by hand troweling. This procedure will produce a monolithic surface but at the bottom of the quality scale—one with little abrasion resistance and poor dusting qualities.

8. Stone wearing surface. Tough, fine-grained igneous stone, properly worked into the surface of a monolithic floor, will increase its resistance to abrasion up to 30 percent, according to our tests. This extra surface material is usually referred to as a "hardener" but it should not be confused with liquid hardeners, which save, for a time, a poor concrete. The stone wearing surface applied as described here is to make a good floor originally. The stone wearing surface provides extra life because: (1) the stone itself is highly resistant to abrasion; (2) the surface has a lower water-cement ratio than is possible with a truck-poured slab, and therefore the cement-paste matrix is stronger; and (3) the surface has a greater density than is possible to achieve with only a transit-mix concrete slab.

In our monolithic work we use a hard, tough basaltic or granitic rock because, in my opinion, traprock has proved its superiority in point of ability to withstand abrasion and shock and in ability to remain bonded to the cement matrix. One reason for this later point is that with the relatively large particles used (relatively larger than other materials used for wearing surfaces), it is possible to achieve better penetration and thus a better "keying" into the slab.

Good results can be achieved only if a sufficient quantity of stone is used and if it is applied evenly and to a sufficient depth to ensure that the stone wearing surface is adequately keyed into the cement matrix. In addition, the stone must be graded properly and tests must be made to determine its toughness and hardness.

We use stone ⅛ in. to ⅜ in. in size. Crushed, angular stone is needed, free from round, flat and elongated pieces because they are likely to chip out. The stone is prepared first by a thorough wetting and then by a thorough mixing with 1 volume of cement to 2 volumes of stone until it is completely covered with cement paste. (When the cement content of the slab concrete is high, it is preferable to use 1 volume of cement to 2½ volumes of stone.) This mixture is spread on the screeded surface at the rate of about 1½ lb per sq ft of surface, which is compacted to a depth of about ⅜ in.

9. Floating. A float machine of the proper design imbeds the stone in the surface and smooths and levels the surface as well. To obtain the coverage indicated above, it may be necessary to apply the stone in several layers, with floating between applications. This operation leaves the surface ready for floating by trowel machines equipped with float blades. Disc power floats should never be used on monolithic work as they leave a rough, uneven surface.

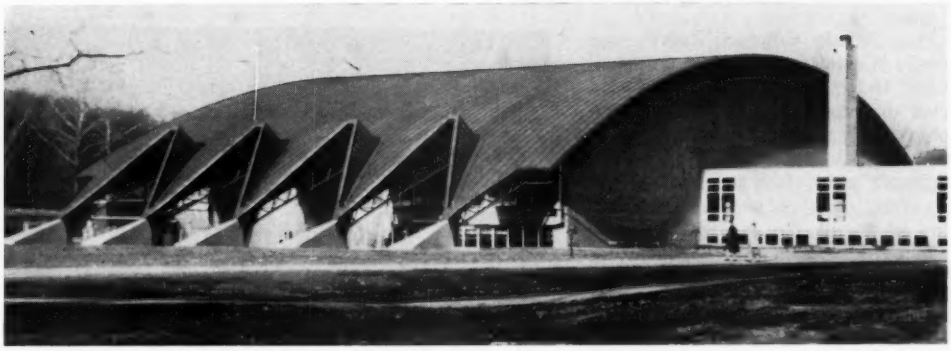
Power floating should not be started until the slab can support the weight of a man without indentation. Power floating brings excess water to the surface, where it can evaporate, makes an even surface, and consolidates the upper layer of the slab by filling all voids or pockets. The use of a power float permits the use of a much stiffer concrete, which gives a floor with less volume change and better wearing qualities. Overfloating or floating when the slab is too wet will bring an excessive amount of fines to the surface. These fines will later wear off of the surface, dusting and leaving an inferior floor.

10. Troweling. The slab should then stand until all water sheen has disappeared, when it should be machine troweled several times to produce a smooth, hard finish. Final troweling, or burnishing, should be done by hand and only when the concrete is so hard that no mortar accumulates on the trowel and a ringing sound is heard as the trowel is drawn over the surface. (A more detailed examination of what troweling accomplishes will be part of the second article in this series.)

11. Curing. Monolithic floors can be cured either by flooding with water or by sealing the surface. Water curing is the preferred method, but often building construction interferes with water curing so that sealers must be used.

Water curing should continue for at least 14 days in cold weather below 70 deg F. When high-early-strength cements are used in the slab concrete, the curing time is 5 days under cold conditions, and 3 days in hot weather. In a heated enclosure in cold weather special care is needed to make sure the slab is saturated at all times. Water curing should be started as soon after finishing as possible, but not later than the following morning. When water curing is used, the floor should be covered with a heavy paper like Sisalkraft or polyethylene so that the curing water is retained for the appropriate time.

Unlike toppings, monolithic floors can be cured by retaining evaporable water with a sealer. When sealers are used they must have at least 30 percent of solids. With a solid content in that range, coverage should not be greater than 400 sq ft per gal of sealer. Coverage should never exceed 500 sq ft per gal, no matter what the solids content. Sealer coverage must be uniform.



Lamella roof with novel dormers provides a span length of 252 ft and width of 113 ft 6 in. for athletic building of Ladue, Mo., Junior High School.

Lamella roof —a spidery welded-truss network

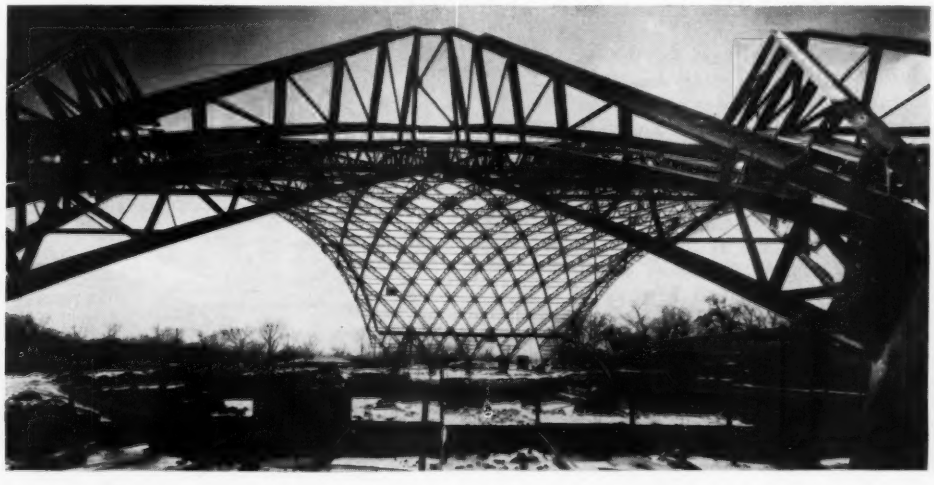
RUSSELL ELFVIN, District Engineer, The Lincoln Electric Company, St. Louis, Mo.

Striking architectural originality is coupled with a high ratio of strength to weight in welded lamella roof framing. This design also provides a long span without supporting columns. One of its most recent applications is in the athletic building for the Junior High School in Ladue, Mo., a suburb of St. Louis.

Here the lamella roof frame has a span length of 252 ft and a width of 113 ft 6 in. The diamond-shaped pattern of interlaced open-web trusses was built up first in the shop by arc welding of angles, T's, and flats in jigs; it was then assembled by welding in the field, with the aid of temporary steel scaffolding or shoring. It is of interest to note that this long-span roof weighs only 9.38 lb per sq ft including dormer framing, closures, end-wall columns, and related miscellaneous framing.

The Ladue school roof span of 252 ft springs from five sloping concrete buttresses at each end, to which it is pin-connected. The roof is erected first. Then the building structure—of steel, masonry and glass—is erected under and up to the roof. The floor level is several feet below the ground level. The roof is designed with four dormers on each side, to admit sufficient air and light to the building proper.

There are 16 equal spacings across the arch length. A single lamella unit spans two spacings and is connected at the center and both ends to similar units. Bolts were used as temporary fit-up connections, and weld deposition was started after all fit-up was complete. In view of the short increment of structure used, it is interesting that only four lines of scaffolding were employed for centering. The points of support were located at joints 2 and 4, counting up from the



Roof is shop welded in sections resembling open-web trusses, then field welded into the span with the aid of tubular shoring.

spring line on each side, leaving the center 8 joints unsupported for erection. The structure was cantilevered over the scaffolding 4 joints or approximately 67 ft, and connected at the center to the members from the opposite side. Sufficient scaffolding was used for approximately one third the length of the building and advanced as erection proceeded.

During roof erection, excavation of earth for below-grade floors between rows of scaffolding proceeded normally. Following precast deck and copper roof installation, the foundations, floors, walls and other functions contained under the arched roof were installed under cover. The only work for this building preceding the roof erection was installation of the buttresses and provision of access by the general contractor. Work in the adjacent classroom wings was scheduled in advance of that on the "activities" building housed under the lamella roof.

Including under the lamella are a gymnasium, an auditorium with stage facilities, a cafeteria, all mechanical equipment for the site, a swimming pool, band rooms, storage space, offices, home economics classrooms and equipment, and covered outside play areas.

The exterior and some interior brick walls are laced with columns braced for wind and lateral stability by attachment to the roof structure at the column tops and, of course, to the foundations at the bottom. The columns were hung from the roof structure until the foundations were poured up to the base plates.

A major part of the fabrication was done on the job using American Welding Society class E-6014 electrode. This is a shielded-arc electrode having iron powder in the coating for faster deposition of weld metal. It can be used in all positions on either a-c or d-c welding equipment.

Engineering consultant for the design of the lamella roof was Roof Structures, Inc., Webster Grove, Mo. Fabrication of the lattice-truss sections was handled by Stupp Brothers Bridge and Iron Company, St. Louis, using welding equipment and electrodes furnished by Lincoln Electric.

Erector was the H. W. Kroeger Erection Company, St. Louis. Architects were Murphy and Mackay of St. Louis; general contractor the Cristina Construction Company, St. Louis. Temporary tubular scaffolding for shoring the roof sections during erection is a specialty product of the Patent Scaffolding Company, Long Island City, New York.

ENGINEERS' NOTEBOOK

Stress analysis of space frames

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Use of pin-jointed space frames has increased greatly in recent years. However, what is possibly the simplest method for determining primary stresses in such frames has been largely neglected by textbooks and design offices in the United States. This method, called the method of "tension coefficients," was developed independently in Europe by Prof. H. F. B. Müller-Breslau[1] and Sir Richard Southwell[2]. Although it is now described in several standard textbooks used in England and has received occasional mention in publications in this country (for example, see references 3, 4, and 5), the simplicity of this procedure has not been brought to the attention of American engineers generally.

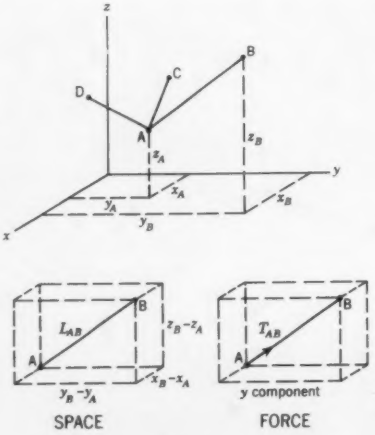


FIG. 1

Consider joint A and the member AB of the space frame shown in Fig. 1. Assuming the force in member AB to be tension, denoted by T_{AB}, the length of the member being L_{AB}, draw the force and space diagrams for the bar. It is seen that the force component along any axis is to the force in the member as the component of length along that axis is to the length of the member; that is,

$$\frac{x \text{ component of force}}{T_{AB}} = \frac{x_B - x_A}{L_{AB}}$$

or

$$x \text{ component of force} = \frac{T_{AB}\ (x_B - x_A)}{L_{AB}}$$

Likewise

$$y \text{ component of force} = \frac{T_{AB}}{L_{AB}}\ (y_B - y_A)$$

$$z \text{ component of force} = \frac{T_{AB}}{L_{AB}}\ (z_B - z_A)$$

The ratio T_{AB}/L_{AB} is denoted by t_{AB} and is the "tension coefficient" of member AB. Applying the above procedure to other members connected to A we obtain:

Resultant force component in direction of x increasing,

$$= t_{AB}\ (x_B - x_A) + t_{AC}\ (x_C - x_A) + t_{AD}\ (x_D - x_A) + \text{etc.}$$

It is assumed that the force in any member is tension and it will be noted that for any bar that is inclined "backwards" in the x direction a negative term will be obtained.

Considering any external forces at joint A to be resolved into components along the directions of the coordinate axes and noted by X_A, Y_A, Z_A, we equate the resultant forces to zero in each di-

rection for equilibrium at the joint.

Direction x: $0 = X_A + t_{AB}\ (x_B - x_A) + t_{AC}\ (x_C - x_A) + t_{AD}\ (x_D - x_A)$ + etc.

Direction y: $0 = Y_A + t_{AB}\ (y_B - y_A) + t_{AC}\ (y_C - y_A) + t_{AD}\ (y_D - y_A)$ + etc.

Direction z: $0 = Z_A + t_{AB}\ (z_B - z_A) + t_{AC}\ (z_C - z_A) + t_{AD}\ (z_D - z_A)$ + etc.

We can proceed from joint to joint, writing three such equations at each joint. In a statically determinate space frame there will be enough simultaneous equations to solve for the unknown tension coefficients and reactions. Solving these equations yields tension coefficients t_{AB}, t_{AC}, etc. Forces T_{AB}, T_{AC}, etc., can then be calculated as follows:

$T_{AB} = t_{AB}\ L_{AB}$, $T_{AC} = t_{AC}\ L_{AC}$, etc.

The notation used above is that used by Southwell but an obvious simplification is to designate the tension coefficient of each member by a single letter or figure. Thus, $t_{AB} = r$, $t_{AC} = s$, and $t_{AD} = t$.

A numerical example

In the derrick of Fig. 2, with vertical and horizontal loads applied at joint A, assume that all joints are made with frictionless pins or balls and sockets, and that pinned supports are provided at joints F, G, and H. Thus each bar will carry only an axial force, to be calculated.

Choose positive directions for the x, y, and z axes as shown. Equilibrium equations can now be written for each joint according to the method of tension coefficients. At joint A, in the x-direction, it is seen that the projecton of bar AB on the x-axis is $(x_B - x_A) = -7$ ft. The projection of bar AD is $(x_D - x_A) = -4$ ft. The projection of bar AE is $(x_E - x_A) = -4$ ft. Since no component of external force is applied in the x-direction, our first equation becomes,

$$-7a - 4b - 4c = 0$$

where a, b, and c are the tension coefficients for bars AB, AD, and AE, respectively. At joint A, in the y-direction, the y-projections of L_{AB}, L_{AD}, and L_{AE} are, respectively, 0, -1 ft, $+1$ ft. An external force of 1 kip is applied at joint A in the positive direction of y, so our second equation becomes,

$$0a - 1b + 1c + 1 = 0$$

At joint A, in the z-direction, the z-projections of L_{AB}, L_{AD}, and L_{AE} are found to be, respectively, 0, -10 ft, -10 ft. An external force of 5 kips is applied in the negative direction of z, so our third equation becomes,

$$0a - 10b - 10c - 5 = 0$$

For other joints, the following equations are obtained:

Joint	Direction	Equation
A	x	$-7a - 4b - 4c = 0$
	y	$-b + c + 1 = 0$
	z	$-10b - 10c - 5 = 0$
B	x	$7a + 3d + 3e = 0$
	y	$d - e = 0$
	z	$-10d - 10e - 10f = 0$
C	x	$3g + 3h = 0$
	y	$g - h = 0$
	z	$10f - 10q = 0$
D	x	$4b - 3e - 3h + 3l + 3m - 3p = 0$
	y	$b + e + h + 2j + 3l - m + p = 0$
	z	$10b + 10c - 10l - 10m - 10p = 0$
E	x	$4c - 3d - 3g + 3k - 3n = 0$
	y	$-c - d - g - 2j + k - n = 0$
	z	$10c + 10d - 10k - 10n = 0$

We now have 15 unknown tension coefficients and 15 independent simultaneous equations. These equations are to be solved for the tension coefficients. If desired, three additional equations can be written for each of the joints F, G, and H. From these equations the x, y, and z components of reaction at each point of support can be found. Or, of course, the external reactions can be found from a free-body diagram of the entire space truss.

The order in which the above equations are solved is important and follows the normal procedure of dealing with pin-jointed frames. Since there are three equations at each joint, a joint with not more than three unknowns is first selected. These unknowns can be found entirely from the equations at this joint. In the present example we start at joint A, finding a, b, and c. We proceed then to joint B, which now has only three unknowns, d, e, and f. Equations at C, E, and D, in that order, are then solved.

Tabulated values of the tension coefficients as found from the above equations are given below. Now axial forces can be found by multiplying tension coefficient by length of member. A plus answer indicates that the assumption of a tensile force was correct. A minus answer indicates a compressive force.

Member	Tension Coefficient, t	Length L, ft	Axial Force $T = tL$, kips
AB	$a = +2/7 = +0.286$	7	$+2.00$
AD	$b = +1/4 = +0.25$	10.82	$+2.71$
AE	$c = -3/4 = -0.75$	10.82	-8.12
BE	$d = -1/3 = -0.333$	10.49	-3.50
BD	$e = -1/3 = -0.333$	10.49	-3.50
BC	$f = +2/3 = +0.667$	10	$+6.67$
CE	$g = 0$	3.16	0
CD	$h = 0$	3.16	0
DE	$j = +7/8 = +0.875$	2	$+1.75$
EF	$k = -5/24 = -0.208$	10.49	-2.18
DF	$l = -7/12 = -0.583$	10.86	-6.33
DG	$m = +5/24 = +0.208$	10.49	$+2.18$
EH	$n = -7/8 = -0.875$	10.49	-9.18
DH	$p = +7/24 = +0.292$	10.49	$+3.06$
CH	$q = +2/3 = +0.667$	10	$+6.67$

It is evident that the above method is merely the so-called method of joints simplified by the concept of a tension coefficient; that is:

$$a = t_{AB} = T_{AB}/L_{AB}$$

The resulting equations are simple, compact, and easily visualized by the designer as he writes them down. Results are quickly checked, and the method in general will show economy of time when compared to other methods. Economy of time is particularly evident when it is necessary to analyze a space frame for several different loading conditions, as is frequently the case in practice.

The method is completely applicable to a coplanar truss, of course. One coordinate axis disappears and the work is thereby simplified.

The concept and notation of a tension coefficient can also be used in solving for forces in truss members by the method of sections, as well as by the method of joints. Where either a space truss or a coplanar truss is solved by the method of sections, the use of tension coefficients will simplify the resulting equations in much the same way as in the example given here.

Bibliography

[1] Müller-Breslau, H. F. B. *Die Neueren Methoden der Festigkeitslehre.* Leipzig, 3rd edition, 1904.

[2] Southwell, R. V. "Primary Stress-Determination in Space Frames." *Engineering*, London, Feb. 6, 1920.

[3] Wagner, H. "The Analysis of Aircraft Structures as Space Frameworks." NACA TM 522, 1929.

[4] Pippard, A. J. S. "Stress Analysis for Space Frames." Civil Engineering, December 1935.

[5] Peery, David J. *Aircraft Structures*, pp. 32-36, McGraw-Hill Book Co., Inc., 1949.

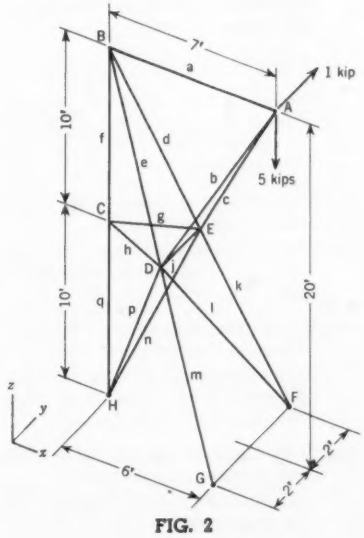


FIG. 2

AMERICAN SOCIETY OF CIVIL ENGINEERS

Phoenix Convention

PROGRAM FEATURING WATER RESOURCES

Headquarters: Hotel Westward Ho, Phoenix, Ariz. **April 10-14, 1961**

REGISTRATION

Hotel Westward Ho, Kachina Lounge

Sunday, April 9, 2:00 p.m. to 5:00 p.m.

Monday through Thursday, 8:00 a.m. to 5:00 p.m.

Friday, April 14, 8:00 a.m. to 12:30 p.m.

Registration fee, $5.00 for members and guests. No fee for ladies or students.

HOTEL ACCOMMODATIONS

Headquarters for the Phoenix Convention will be the Hotel Westward Ho at Central and Filmore Streets in Phoenix. Arrangements have been made to house Convention visitors at the Headquarters Hotel to the limit of space in the order that reservation requests are received. To assure facilities at the Westward Ho, send in your reservation request early. To assist you, a coupon is included in this issue on page 112, to be sent directly to the Headquarters Hotel.

MONDAY MORNING

APRIL 10

Highway Division with cooperation of City Planning Division

8:30 a.m. Turquoise Room

Presiding: Earle V. Miller, Program Committee, Highway Div., and Everett B. Mansur, Exec. Committee, City Planning Div.

8:30 Integration of Urban and Transportation Planning

J. B. BLACKBURN, Director, Institute of Transportation and Traffic Eng., Univ. of Arizona, Tucson.

9:20 Land-Use Aspects of L.. away Location

JOHN TSAGURIS, Assistant Planning Director, City and County Planning Dept., Tucson, Ariz.

10:10 City-County Coordination in Planning Urban Transportation

LYALL A. PARDEE, City Engr., Los Angeles, Calif.

AUTHORS' BREAKFASTS

7:15 a.m. Corral Room

Briefing sessions for speakers, discussers, and program officials, each Convention day. Admission is by invitation only.

Presiding: HANEN H. WILLIAMS, Chairman of the Technical Program Committee

Irrigation and Drainage Division

8:30 a.m. Council Room

Presiding: K. Q. Volk, Chairman, and N. A. Christensen, Exec. Committee, Irrigation and Drainage Div.

8:30 Lower-Cost Canal Linings Through Mechanization

CARL R. WILDER, Regional Conservation Engr., Portland Cement Assoc., Los Angeles, Calif.

9:00 Water Supply and Flood Forcasting

HAROLD WILM, Commissioner of Conservation, State of New York, Albany, N. Y.

9:30 Watershed Management; a New Science

A. L. MCCOMB, Head, Dept. of Watershed Management, Univ. of Arizona, Tucson, Ariz.

10:00 Consumptive Use of Water by Phreatophytes and Hydrophytes

HARRY F. BLANEY, Western Soil and Water Management Branch, ARS, USDA, Los Angeles, Calif.

Pipeline Division

8:30 a.m. Colonial Room

Presiding: Fred C. Culpepper, Jr., Exec. Committee, Pipeline Div.

8:30 Pipeline Flotation Studies Report

R. E. RAIT, Vice President, Houston Branch, Humble Oil Co., Houston, Tex.

9:15 Colorado River Crossing

MAURICE E. FULLER, Chief Engr., Pacific Gas and Lighting Supply Co., Los Angeles, Calif.

10:00 Pipe Jointing

JOSEPH SIEGEL, Dept. of Water and Power, Los Angeles, Calif.

Sanitary Engineering Division

8:30 a.m. Corral Room

Presiding: Dwight F. Metzler, Member, Exec. Committee, Sanitary Eng. Div.

8:30 An Analysis and Report on SED Activities in the Field of Water Resources

PAUL W. EASTMAN, JR., Regional Program Director, USPHS, San Francisco, Calif.

9:00 Is the Nation Really Running Short of Water?

HON. ROBERT S. KERR, U.S. Senator, Oklahoma.

9:30 Water Supply Management for a Paper Mill

RAYMOND E. BAKER, Southwest Forest Industries, Inc., Glendale, Ariz.

10:00 Ark-Red-White Water Resources Management Study

JEROME H. SVORE, Regional Program Director, USPHS, Dallas, Tex.

Department of Conditions of Practice

11:00 a.m. Turquoise Room

Sponsored by the Committee on Registration of Engineers

Presiding: Ellis E. Paul, Chairman, Committee on Registration of Engineers

A Review of the NCSBEE Revised Model Law

GEORGE W. BRADSHAW, Past Chairman, Committee on Registration of Engineers

Corporate Practice at Defined in the NCSBEE Revised Model Law

JAMES W. GONGWER, Vice Chairman, Committee on Registration of Engineers

The Place of Land Surveying in the Registration Law

WILLIAM A. WHITE, Member, Committee on Registration of Engineers

Discussion

CIVIC LUNCHEON

Monday, April 10

12:30 p.m. Thunderbird Room

Presiding: GLENN W. HOLCOMB, President, ASCE

Toastmaster: ELMER J. MAGGI, General Chairman, Phoenix Convention Committee

Greetings from the City of Phoenix: HON. SAM MARDIAN, Mayor

Speaker: HON. BARRY GOLDWATER, United States Senator from Arizona

All members, guests, ladies and friends of the Society are cordially invited to attend.

MONDAY AFTERNOON

APRIL 10

Highway Division

2:30 p.m. Turquoise Room

Presiding: Archie N. Carter, Exec. Committee, Highway Div.

2:30 Panel Discussion on County Highway Management

C. F. ROGERS, Bur. of Public Roads, Washington, D. C.; J. M. EVANS, Minnesota Dept. of Highways; JOHN B. BENSON, County Engr., Manatee County, Fla.; JOHN M. LAMBIE, County Engr., Los Angeles County, Calif.; ROBERT T. CARRIER, County Engr., Batavia, N. Y.

Irrigation and Drainage Division

2:30 p.m. Council Room

Presiding: Herbert E. Prater, Member, Exec. Committee, Irrigation and Drainage Div.

2:30 Irrigation and Drainage Studies of Texas Rivers

ROLLAND F. KASER, Chief Planning Engr., U.S. Study Commission, Houston, Tex.

3:00 Factors Affecting the Safe Yield of Ground-Water Basins

JOHN F. MANN, JR., Consulting Geologist, La Habra, Calif.

3:30 Ground-Water Technology to Solve Litigation Problems in Colorado

EDWARD A. MOULDER and EDWARD JENKINS, District Engrs., USGS, Denver, Colo.

4:00 Erosion and Sedimentation of Bed of the Lower Colorado River

ARTHUR MITCHELL, Chief, Div. of Construction and River Control, USBR, Boulder City, Nev.

Pipeline Division

2:30 p.m. Colonial Room

Presiding: Donald E. Adams, Secretary, Pipeline Div.

2:30 Automatic Field Welding of Pipe Joints

WILBUR A. SAYLOR, Chief Metallurgist, Consolidated Western Steel Div., Los Angeles, Calif.

3:15 The American Home—a Pipeline Problem

M. J. CROWLEY, Div. Engr., El Paso Natural Gas Co., El Paso, Tex.

4:00 Pipeline Construction on the San Diego Aqueduct

RICHARD S. HOLMGREN, General Manager and Chief Engr., County Water Authority, San Diego, Calif.

4:30 Major Pipelines in the Phoenix Area

HAROLD W. YOST, Yost and Gardner, Engrs., Phoenix, Ariz.

Sanitary Engineering Division

2:30 p.m. Corral Room

Presiding: Dwight F. Metzler, Member, Exec. Committee, Sanitary Eng. Div.

2:30 The Effects of Hydrogen Sulfide on Concrete Structures

BERNAL SWAB, Camp, Dresser, McKee, Boston, Mass.

3:00 Latest Development in Hydrogen Sulfide Control

RICHARD POMEROY, Pomeroy and Associates, Pasadena, Calif.

3:30 Protective Coatings for Concrete Sewers

WILLIAM CARROLL, James Montgomery, Consulting Engr., Pasadena, Calif.

4:00 Experiences in Hydrogen Sulfide Problems

FRANK H. MILLER, General Manager and Chief Engr., Hampton Roads Sanitation Dist., Norfolk, Va.

Surveying and Mapping Division

2:30 a.m. Turquoise Room

Presiding: O. R. Bosso, Exec. Committee of the Div.

2:30 Adjustment of Control Traverse Nets

E. D. MORSE, Supt. of Civil Eng., Houston Lighting and Power Co., Houston, Tex.

3:10 Surveyor's Footsteps

WILLIAM C. WATTLES, Glendale, Calif.

3:50 Control Surveys for the Glen Canyon Dam

U. S. Bur. of Reclamation

4:30 New Geological Maps for Arizona

FRED J. MCCRORY, Arizona Bur. of Mines, Tuscon, Ariz.

ICE BREAKER PARTY

Monday, April 10

6:30 p.m.-7:30 p.m. Turquoise Room

All registrants and their wives are invited to enjoy the hospitality of the Arizona Section at this first general gathering of the Phoenix Convention. This will provide an opportunity for meeting and greeting friends, with cocktails.

The ticket for admission is your Convention badge. Be sure and wear it.

TUESDAY MORNING

APRIL 11

Highway Division

8:30 a.m. Turquoise Room

Presiding: Robley Winfrey, Chairman, Committee on Highway Planning and Finance

8:30 Highway Need Studies from a National Viewpoint

J. P. BUCKLEY, Automotive Safety Foundation, Washington, D. C.

9:20 Highway Need Studies from a State Highway Department Viewpoint

R. A. CURRIE, Chief, Div. of Highway Planning, Missouri State Highway Dept., Jefferson City, Mo.

10:10 Highway Need Studies from a County Viewpoint

R. P. O'NEILL, County Engr., Butte County, Calif.

Hydraulics Division

8:30 a.m. Thunderbird Room

Presiding: Maurice L. Dickinson, Chairman, Hydraulics Div., and Charles C. McDonald, Committee on Surface Water Hydrology

8:30 Transmission Losses of Streamflow in Ephemeral Sand Bed Channels of the Southwest

ROBERT V. KEPPEL, Project Supervisor, Agricultural Research Service, Tucson, Ariz.

9:00 Some Effects of Irrigation on Quality of Stream Flow, Colorado River Basin

WILLIAM V. IORNS, Hydraulic Engr., U.S.G.S., Salt Lake City.

9:30 Transition Zone at the Interface in Coastal Aquifers
JACOB BEAR and DAVID K. TODD, Dept. of Civil Eng., Univ. of Calif., Berkeley, Calif.

Pipeline Division

8:30 a.m. Colonial Room

Presiding: John J. Koy, Dist. Engr., United Gas Pipeline Co., San Antonio, Tex.

8:30 Expanding Colorado River Aqueduct to Full Capacity
ROBERT B. DIEMER, General Manager and Chief Engr., Metropolitan Water Dist. of Southern Calif., Los Angeles, Calif.

9:00 Aerial Photography in Pipeline Location
PHILIP GUSS, Lockwood, Kessler & Bartlett, Inc., Syosset, N. Y.

9:30 Pipeline Construction by Use of Helicopters
R. L. SUGGS, President, Petroleum Helicopters, Inc., New Orleans, La.

Waterways and Harbors Division

8:30 a.m. Corral Room

Presiding: J. W. Johnson, Exec. Committee of Div.

8:30 Effects of Chilean Seismic Seawave
JACK STIRTON and ORVILLE MAGOON, U. S. Army Engr. Dist., San Francisco, Calif.

9:15 The Problems of the Fraser River
T. M. PATTERSON, Director, Water Resources Board, Dept. of Northern Affairs and National Resources, Canada.

10:00 Waves on Inland Reservoirs: Freeboard Determination
E. W. MCCLENDON, U. S. Army Engr. Div., Missouri River, Omaha, Nebr.; A. L. COCHRAN, Office, Chief of Engineers, Washington, D. C.; and THORNDIKE SAVILLE, JR., Beach Erosion Board, Washington, D. C.

Water Resources Joint Session

Irrigation and Drainage Div. with Sanitary Eng. Div.

8:30 a.m. Council Room

Presiding: John J. Baffa, Chairman, Sanitary Eng. Div., and Paul H. Berg, Member, Exec. Committee, Irrigation and Drainage Div.

8:30 Salvage of Water by Controlling Phreatophytes
SELDON F. CRAMER, Chief, Planning and Reports Branch, U.S. Corps of Engineers, Los Angeles.

9:00 Change in Water Quality Due to Irrigation in Relation to Other Water Uses
RAYMOND HILL, Leeds, Hill and Jewett, Los Angeles, Calif.

9:30 Use of Return Flow in Irrigation Project Design
DEAN E. BISHOFF, Area Engr., U.S.B.R., Logan, Utah.

10:00 Importance of Re-Use of Waste Water
JOHN MERRELL, Special Asst. for Sanitation, 11th Naval Dist., San Diego, Calif.

10:30 Use and Re-Use of Water as Exemplified by Phoenix Water and Sewerage Programs
DARIO TRAVAINI, Supt. of Water and Sewers, Phoenix, Ariz.

Department of Conditions of Practice

11:00 a.m. Turquoise Room

Presiding: S. W. Freese, Chairman, Committee on Engineers in Public Practice

Session by Committee on Engineers in Public Practice on "The Effectiveness of Engineers in Public Practice"

11:05 Professional Goals of Engineers in Public Practice
RANDLE B. ALEXANDER, Bridge Engr., Texas State Highway Dept.

11:25 Problems Affecting Effectiveness of Engineers in Public Practice
BLUCHER A. POOLE, Chief Engr., Indiana State Board of Health

11:40 Measures of the Effectiveness of Engineers in Public Practice
MERCEL J. SHELTON, Consulting Engr., LaMesa, Calif.

11:55 Discussion

GENERAL MEMBERSHIP LUNCHEON

Tuesday, April 11

12:30 p.m. Thunderbird Room

Presiding: GLENN W. HOLCOMB, President, ASCE

Toastmaster: JOHN C. PARK, Chairman, Conditions of Practice Program Committee, Phoenix Convention

Speaker: G. BROOKS EARNEST, President, Fenn College, Cleveland, Ohio

Subject: The Engineering Profession and Practical Action

All members, guests and friends of the Society are invited to attend.

TUESDAY AFTERNOON

APRIL 11

Highway Division

2:30 p.m. Turquoise Room

Presiding: William A. Bugge, Chairman, Highway Div.

2:30 Traffic
WILBUR SMITH, Wilbur Smith & Assocs., New Haven, Conn.

3:15 Toll Roads and Their Relation to Our Highway Program
CHARLES DELEUW, DeLeuw, Cather & Co., Chicago, Ill.

4:00 Rapid Transportation
IRVAN F. MENDENHALL, Daniel, Mann, Johnson & Mendenhall, Los Angeles, Calif.

4:30 The Freeway System
ELLIS L. ARMSTRONG, Better Highways Information Service, Washington, D. C.

Sanitary Engineering Division

2:30 p.m. Corral Room

2:30 Design, Operation and Maintenance of Oxidation Ponds
WILSON W. TOWNE, U. S. Public Health Service, Cincinnati, Ohio.

3:00 Stabilization of Sewage Treatment Plant Effluents by Flora and Fauna
WILLIAM BECK, Biologist, Florida State Health Dept.

3:30 Sewerage for Metropolitan San Diego
PAUL BEERMAN, Director of Public Works, San Diego, Calif.

4:00 Design and Operation of an Oxidation Pond Under Extreme Weather Conditions

Soil Mechanics and Foundations Division

2:30 p.m. Turquoise Room

Presiding: Jorge O. Osterberg, Member, Exec. Committee

2:30 Service Record—Abutment Drainage—Chief Joseph Dam
ALLEN S. CARY, Geologist, Seattle Dist., and GLEN R. BUTTERFIELD, Engr., Walla Walla Dist., U.S. Corps of Engineers.

3:00 Slope Protection Along Reservoirs
HARRY DRAKE, Chief, Foundations and Materials Branch, Walla Walla Dist., U.S. Corps of Engineers.

3:30 Control of Seepage and Drainage —Kennewick and Pasco Levees
LEE JONES, Chief, Soils Sect.,

Walla Walla Dist., U.S. Corps of Engineers.

4:30 Application of Soil Mechanics Theory to Foundation Investigation in the Arid Southwest
JAMES E. WARNE, JR., President, and B. D. SERGENT, Vice President, Warne-Sergent, Soil Mechanics and Foundations Engrs., Phoenix, Ariz.

Surveying and Mapping Division

2:30 a.m. Council Room

Presiding: O. R. Bosso, Exec. Committee of the Div.

2:30 Photo Interpretation
THOMAS W. MITCHAM, Dept. of Geology, Univ. of Arizona, Tucson.

3:10 Modern Optical Instruments
PORTER W. MCDONNELL, Product Manager, Surveying, Dietzgen Co.

3:50 The Geodimeter and Tellurometer
CARL WINIKKA, Photogrammetry and Mapping, Arizona Highway Dept.

Water Resources Joint Session

Irrigation and Drainage Div., Hydraulics Div., Waterways and Harbors Div.

2:30 p.m. Council Room

Presiding: J. W. Johnson, Waterways and Harbors Div., N. A. Christensen, Irrigation and Drainage Div.

2:30 Channel Stabilization Works for the San Gabriel River
ALBERT P. GILDEA and JOSEPH C. SCIANDRONE, U.S. Army Engr. Dist., Los Angeles, Calif.

3:15 Levee Revetment and Bank Stabilization, Lower Colorado River
JOHN S. MCEWAN, U. S. Bur. of Reclamation, Region 3, Boulder City, Nev.

3:45 Stabilization of the Channel of the Middle Rio Grande in New Mexico
ROBERT C. WOODSON, U.S. Army Engr. Dist., Albuquerque, N. Mex.

POWER DIVISION FIELD TRIP

Tuesday, April 11

Busses will leave Hotel Westward Ho at 2:30 p.m.

This excursion will take registrants on a visit to the Agua Fria Steam Power Plant of the Salt River Project. This plant occupies 80 acres of former irrigated cotton land a few miles northwest of Glendale, Ariz. Two generating units, each with a 100,000-kw tandem-compound, double-flow turbine were placed in operation in 1957. A third unit with a 165,000-kw tandem-compound, double-flow turbine is scheduled to go on the line March 1, 1961. Total installed plant cost is approximately $45,000,000.

Busses will return to the Westward Ho at about 5:30 p.m.

WESTERN BARBECUE DINNER

Tuesday, April 11

6:30 p.m. Busses leave Hotel Westward Ho

7:30 p.m. Barbecue and Entertainment

Western barbecue dinner served on the desert under the stars near the foothills of Superstition Mountain, famous for the Lost Dutchman's mine.

WEDNESDAY MORNING APRIL 12

ECPD INSPECTORS BREAKFAST

Wednesday, April 12

7:30 a.m. Saratoga Room

Construction Division

8:30 a.m.

Presiding: Neville S. Long, Senior Construction Engr., Southern Calif. Edison Co., Los Angeles

8:30 Construction Planning of the Mammoth Pool Project
GEORGE W. SAUL, Asst. Manager of Construction, Bechtel Corp., San Francisco, Calif.

9:00 Construction Planning for Mammoth Pool Power Tunnel
BOYD PAULSON, Project Manager, Utah Construction and Mining Co., San Francisco, Calif.

9:30 Construction Planning for Mammoth Pool Diversion Tunnel
B. L. PERKINS, Dist. Manager, Morrison-Knudsen, Inc., Boise, Idaho.

10:00 Construction Planning for Mammoth Pool Penstock
EDWARD M. MACIAS, Senior Field Engr., Consolidated Western Steel Corp., Los Angeles, Calif.

Highway Division

8:30 a.m. Turquoise Room

Presiding: R. Robinson Rowe, Chairman, Committee on Pipeline Crossings, Highway Div.

8:30 Pipeline Encasement Practice of Arizona Highway Department
CARL W. MCPHERSON, Permit Engr., Arizona Dept. of Highways.

9:00 Encasement of Water Line Crossings
LEO LOUIS, JR., Chairman, A.W.W.A. Committee on Pipeline Crossings, Gary-Hobart Water Corp., Gary, Ind.

9:30 Rigid Encasement of Water Lines
JOHN G. HENDRICKSON, JR., Amer. Concrete Pressure Pipe Assoc., Chicago, Ill.

10:00 Committee Findings on Encasement Practice
HUBERT H. BROWN, Phoenix, Ariz.

Water Resources Joint Session

Hydraulics Div., Irrigation and Drainage Div., Power Div., Waterways and Harbors Div.

8:30 a.m. Council Room

Presiding: J. W. Johnson, Waterways and Harbors Div.; Maurice L. Dickinson, Hydraulics Div.

8:30 Land and Water Resource Planning in the Southwest
LESTER W. ANGELL, Chief, Eng. Div., and JEROME F. ANDERSON, Chief, Conservation Div., U.S. Study Commission, Southeast River Basins, Atlanta, Ga.

9:15 Land and Water Resource Planning in Texas
CHARLES D. CURRAN, Chief Director, U.S. Study Commission, Texas Basins, Houston, Tex.

10:00 Economics of Multipurpose Project Planning
REED A. ELLIOT, Chief, Div. of Water Control Planning, TVA, Knoxville, Tenn.

Soil Mechanics and Foundations Division

8:30 a.m. Colonial Room

Presiding: Thomas M. Leps, Chairman of the Div.

8:30 Rock Excavation for Foundations
HAROLD STUART, Chief, Foundations and Materials Branch, North Pacific Div., U.S. Corps of Engrs., Portland, Ore.

9:00 Tunnel Cost Estimating Based on Geology
L. B. JAMES, Chief Geologist; J. W.

MARLETTE and E. M. WEBER, Engineering Geologists, Dept. of Water Resources, Sacramento, Calif.

9:30 Foundation and Subsidence of the Western Pennsylvania Coal Fields
E. D'APPOLONIA, E. D'Appolonia Assocs., Pittsburgh, Pa.

Structural Division

8:30 a.m. Thunderbird Room

8:30 Irrigation Structures—Helmand Valley, Afghanistan
DALE R. SHOCKLEY, International Eng. Co., Inc., San Francisco, Calif.

9:30 Titan ICBM Hardened Facilities
MARVIN J. KUDROFF, Daniel, Mann, Johnson & Mendenhall, Los Angeles, Calif.

General Business Meeting

11:00 a.m. Turquoise Room

President's Annual Address

RESEARCH AWARDS LUNCHEON

Wednesday, April 12

12:30 p.m. Thunderbird Room

Presiding: GLENN W. HOLCOMB, President, ASCE

Presentation of 1961 Research Awards to:

PROF. DAVID K. TODD, Civil Engineering Dept., Univ. of Calif.

PROF. BRUNO THURLIMANN, Dept. of Civil Eng., Swiss Federal Inst. of Tech., Zurich

PROF. DONALD R. F. HARLEMAN, Hydrodynamics Lab., Mass. Inst. of Tech.

PROF. PHIL M. FERGUSON, Dept. of Civil Eng., Univ. of Texas

PROF. RAYMOND CLOUGH, Dept. of Civil Eng., Univ. of Calif.

All members, guests and friends of the Society are invited to attend.

WEDNESDAY AFTERNOON APRIL 12

Construction Division

2:30 p.m.

Presiding: Otis St. Clayr Struthers, Member, Construction Div. Program Committee, and Lenuel F. Wylie, Project Construction Engr., Glen Canyon Dam, Bur. of Reclamation

2:30 Design Features of Glen Canyon Dam
EARNEST R. SCHULTZ, Head of Concrete Dams Sect., U.S. Bur. of Reclamation, Denver, Colo.

3:05 Film—U.S. Bur. of Reclamation, Current Operations, Glen Canyon Dam

3:35 Concreting Techniques in the Construction of Glen Canyon Dam
JOSEPH PERAINO, Chief Engr., Merritt, Chapman & Scott Corp., New York, N.Y.

4:05 The Staffing and Management of Construction Projects
WALLACE R. RICHMAN, President of Chase, Ward & Gardner, Management Consultants, San Francisco, Calif.

SANITARY ENGINEERING DIVISION FIELD TRIP

Wednesday, April 12

2:30 p.m. Busses will leave Hotel Westward Ho

This excursion includes a trip to the City of Phoenix Squaw Peak Water Treatment Plant at the base of Squaw Peak in north Phoenix. This plant furnishes 90 million gallons of water each day to the City of Phoenix. The water is taken from an irrigation canal; the treatment consists of presedimentation, chemical treatment, coagulation, sedimentation and filtration.

Busses will return to the Westward Ho at about 4:45 p.m.

Highway Division

2:30 p.m. Turquoise Room

Presiding: Wilbur S. Smith, Chairman, Committee on Traffic Eng., Highway Div.

2:30 Use of Traffic Facts and Trends in Highway Administration and Planning
WILLIAM E. WILLEY, State Highway Engr., Phoenix, Ariz.

3:15 The Civil Engineer's Contribution to City Planning
WILLIAM H. CLAIRE, Urban Renewal Planning Consultant, Pasadena, Calif.

4:00 Planning of a Compatible Street and Freeway Network
CHARLES E. HALEY, City Traffic Engr., Phoenix, Ariz.

4:30 Factors Affecting Good Parking Design
MERRITT A. NEALE, Exec. Director, Public Parking Authority, Pittsburgh, Pa.

Water Resources Joint Session

Hydraulics Div., Irrigation and Drainage Div., Power Div., Waterways and Harbors Div.

2:30 p.m. Council Room

Presiding: Kenneth Q. Volk, Chairman, Irrigation and Drainage Div., and Maurice L. Dickinson, Chairman, Hydraulics Div.

2:30 Unification of Parshall Flume Data
SYDNEY DAVIS, Visiting Prof., Cornell Univ., Ithaca, N.Y.

3:00 Soil Draining Ability in Land Classification
CLAUDE L. FLY, Agricultural Research Service, Dept. of Agriculture, Ft. Collins, Colo.

3:45 Research Studies in Ground Water Motion
HERBERT E. SKIBITZKE, U.S.G.S., Phoenix, Ariz.

Soil Mechanics and Foundations Division

2:30 p.m. Colonial Room

Presiding: John Lowe III, Member, Exec. Committee of the Div.

2:30 Mechanism of Sinkhole Formations
JOHN SCHMERTMANN, Prof., Dept. of Civil Eng., Univ. of Florida, Gainesville.

3:00 Mechanism of Subsidence
DON U. DEERE, Prof., Civil Eng. and Geology, Univ. of Illinois, Urbana.

3:30 The Effect of Local Settlement on Foundations for Structures
FRANK E. RICHART, JR., Prof., Dept. of Civil Eng., Univ. of Florida, Gainesville.

Structural Division

2:30 p.m. Thunderbird Room

2:30 Structural Planning of Offshore Drilling Rigs
FREDERICK WILLSEA, John Blume & Associates, Engrs., San Francisco, Calif.

3:10 The Construction of Penstocks and Scroll Cases of the Lewiston Project
J. E. REVELLE and JOHN N. PIROCK, Chicago Bridge and Iron Co., San Francisco, Calif.

3:50 Spillway Gates—Horseshoe Dam
J. A. RAU, Allison Steel Mfg. Co., Phoenix, Ariz.

THURSDAY MORNING

APRIL 13

Construction and Highway Divisions, Joint Session

8:30 a.m. Turquoise Room

Presiding: William E. Willey, Arizona State Highway Engr., Phoenix

8:30 Highway Improvements in the Bisbee Area
OSCAR T. LYON, JR., Dist. Engr., Arizona State Highway Dept., Safford, Ariz.

9:00 Highways and the American Way
K. G. BENTSON, President, Arizona Chapter, Assoc. of Gen. Contractors of America.

9:30 East Los Angeles Interchange
EDWARD T. TELFORD, Asst. Highway Engr., State Div. of Highways, State of Calif., Los Angeles.

10:00 Road Project in Thailand, with Film Showing Operations
WARREN N. RIKER, Vice-President, Foreign Dept., Raymond International Inc., New York, N.Y.

Water Resources Joint Session

Hydraulics Div., Irrigation and Drainage Div., Power Div.

8:30 a.m. Council Room

Presiding: Maurice L. Dickinson, Chairman, and Herbert S. Riesbol, Exec. committee, Hydraulics Div.

8:30 Climatic Trends in the Southwest as Indicated by Archaeological and Pollen Investigations
FRED WENDORF, Assoc. Director for Anthropology, Museum of New Mexico, Santa Fe.

9:00 Evaporation Suppression Studies on Salmaro Lake, Arizona
Q. L. FLOREY, L. O. TIMBLIN, JR., U.S.B.R., and G. E. KOBERG, U.S.G.S., Denver, Colo.

9:30 Inter-Aquifer Flow Through Irrigation Wells
BENJAMIN E. LOFGREN, Hydraulic Engr., U.S.G.S., Sacramento, Calif.

Soil Mechanics and Foundations Division

8:30 a.m Colonial Room

Presiding: Reginald A. Barron, Vice Chairman, Exec. Committee of the Div.

8:30 Resistance of Shallow Pole Foundations in Cohesionless Soils to Large Overturning Moments
BRYANT P. KENT, Instructor, Dept. of Civil Eng., Univ. of Arizona, Tucson.

9:00 Soil and Rock Mechanics Problems on the Main Line Location of the Santa Fe
ROY A. STANE, Chief Construction Engr., A.T. & Santa Fe Railroad, Williams, Ariz.

9:30 Application of Soil Mechanics Theory to Foundation Investigation in the Arid Southwest
JAMES E. WARNE, JR., Vice President, Engineers' Testing Labs., Inc., Phoenix, Ariz.

10:00 Highly Expansive Soil Problems in Highway Subgrade Design in Arizona
U.S. Bur. of Reclamation, Phoenix.

Structural Division

8:30 a.m. Thunderbird Room

8:30 The Analysis of Blue Ridge Dam
R. H. GILMAN, Leeds, Hill & Jewett, Inc., Los Angeles, Calif.

9:15 Various Types of Energy Dissipators
R. J. TIPTON, Tipton & Kalmback, Inc., Denver, Colo.

10:00 Conservation of Cooling Water
ARTHUR C. MILLER, Michael Baker, Jr., Inc., Jackson, Miss.

Department of Conditions of Practice

11:00 a.m. Turquoise Room

Session by Committee on Younger Members

Panel Discussion on "The Incompatibility of Unionism and Professionalism"

Moderator: GLENN L. ENKE, Chairman, Committee on Younger Members

Panel Members: PHILLIP ABRAMS, WILLIAM J. CARROLL, TERRIL C. EWBANK

FACULTY ADVISERS CONFERENCE

Thursday, April 13

9:00 a.m. Saratoga Room

Sponsored by ASCE Committee on Student Chapters

Presiding: Roger H. Nelson, Regional Member, Committee on Student Chapters

Faculty Advisers to 26 ASCE Student Chapters in the Western Region will convene on invitation to discuss Chapter activities. This all-day conference, while primarily for Faculty Advisers, is open to all who may be interested.

GENERAL MEMBERSHIP LUNCHEON

Thursday, April 13

12:30 p.m. Thunderbird Room

Presiding: GLENN W. HOLCOMB, President, ASCE

Toastmaster: ROD J. MCMULLIN, General Manager, Salt River Project, Phoenix

Speaker: SHERMAN HAZELTINE, Chairman of the Board and Chief Exec. Officer, First National Bank, Phoenix

All members, guests and friends of the Society are invited to attend.

THURSDAY AFTERNOON

APRIL 13

Construction Division

2:30 p.m. Council Room

Presiding: Jack Edward McKee, Prof. of San. Eng., Calif. Inst. of Technology, Pasadena

2:30 Background History of Salt Water Conversion
LEWIS G. VON LOSSBERG, Associate, Sheppard T. Powell, Consulting Engr., Baltimore, Md.

3:00 Seawater Conversion Plant, Freeport, Tex.
JAMES T. DUNN (of Philadelphia) and A. N. CHIRICO (of New York), both representing Chicago Bridge & Iron Co.

3:30 Westinghouse Electric Corp.'s Sea-Water Conversion Plant, San Diego, Calif.
ARTHUR R. COTT, Manager, Heat Transfer, Westinghouse Elec. Corp., Lester, Pa.

4:00 Sea Water Conversion Plant, Mandalay, Calif., Construction and Operation
RALPH W. SPENCER, Manager, Engineering Dept., Southern Calif. Edison Co., Los Angeles.

Highway Division

2:30 p.m. Turquoise Room

Presiding: Harmer E. Davis, Director, District 11, ASCE

2:30 Streets for the Urban Traveler
EDWARD M. HALL, Street Improvement Administrator, Phoenix, Ariz.

3:00 Street and Highway Needs in the Phoenix Area
G. L. DRAKE, Wilbur Smith and Assocs., San Francisco, Calif.

3:30 Relationship Between Transportation Facilities and Economic Development

RICHARD ZETTEL, Inst. of Transportation and Traffic Eng., Univ. of Calif.

4:00 Getting the Most from Urban Streets

HERMAN L. DANFORTH, Director of Public Works, Tucson, Ariz.

Hydraulics Division

2:30 p.m.

Presiding: Maurice L. Dickinson, Chairman, Exec. Committee, and Rex A. Elder, Member, Committee on Hydraulic Structures

2:30 Pipe Flow with Artificial Roughness

HARRY H. AMBROSE, Prof. of Hydraulics, Univ. of Tenn., Knoxville.

3:00 Resistance Coefficients in Large Conduits

ROBERT G. COX, Chief, Analysis Sect., Hydraulics Div., Waterways Exp. Sta., Vicksburg, Miss.

3:30 Discharge Measurements by Pitot Traverses in 96-In. Square Conduit

REX A. ELDER, Head, and MARVIN U. SMITH, Hydraulic Engr., Hydraulic Lab., T.V.A., Knoxville.

Power Division

2:30 p.m. Colonial Room

Presiding: M. P. Aillery, Chairman, Power Div.

2:30 Cooling Pond Design as Applied in Arizona

T. J. COTTER, Civil Engr., and A. W. LOTZ, Mechanical Engr., Ebasco Services, Inc., New York.

3:00 Pressure Suppression Reactor Containment—Humboldt Bay Nuclear Unit

F. F. MAUTZ, Supervising Engr., Pacific Gas and Electric Co., San Francisco, Calif.

3:30 The Los Angeles-Pasadena Nuclear Power Plant

L. T. MARINER, Principal Civil Engr., Dept. of Water and Power, Los Angeles, Calif.

4:00 Oak Ridge Gas Cooled Reactor

Irrigation and Drainage Division

2:30 p.m.

Presiding: William Donnan, Secretary, Irrigation and Drainage Div.

2:30 Low-Cost Canal Lining

P. W. TERRELL, Asst. Chief, Canals Branch, U.S. Bur. of Reclamation, Denver, Colo.

3:00 Advance of the Water Front in Border Irrigation

E. R. TINNEY, Asst. Prof., Dept. of Agricultural Eng., and D. L. BASSETT, Director, Albrook Hydraulic Lab., Washington State Univ., Pullman.

3:30 Electric Analog Models to Simulate Ground-Water Systems

BORIS J. BERMES, Analog Model Unit, U.S.G.S., Phoenix, Ariz.

4:00 Evaporation at High Elevations in the San Joaquin River Basin

LEONARD L. LONGACRE, Senior Civil Engr., Southern Calif. Edison Co., San Gabriel.

DINNER DANCE

Thursday, April 13

Phoenix Country Club

6:30 p.m. Busses leave Hotel Westward Ho

7:00 p.m. Dinner and Entertainment

9:00 p.m. Dancing
Dress informal

FRIDAY MORNING

APRIL 14

Hydraulics Division

8:30 a.m.

Presiding: Maurice L. Dickinson, Chairman, Exec. Committee, and Robert B. Banks, Chairman of Committee on Sedimentation

8:30 Back Scour During Floods Above Pits and Basins

PAUL BAUMAN, Consulting Engr., Sierra Madre, Calif.

9:00 Stationary Waves and Antidunes in Alluvial Channels

JOHN F. KENNEDY, Research Fellow, Calif. Inst. of Tech., Pasadena.

9:30 Tractive Force Fluctuations Around the Perimeter of Open Channels

PHILLIP F. ENGER, Hydraulic Engr., U.S. Bur. of Reclamation, Denver, Colo.

10:00 Total Sediment Transport in the Lower Colorado River

JOHN R. SHEPPARD, Hydraulic Engr., U.S. Bureau of Reclamation, Denver, Colo.

LOCAL SECTIONS CONFERENCE

Fri. and Sat., April 14-15

9:30 a.m. Saratoga Room

Representatives of ASCE Local Sections from a selected area about the Convention city will convene for discussion related to the expansion of the Society's activities at the local level.

This conference, which is primarily for invited delegates of the selected Local Sections, is open to all who may be interested in the fundamentals of Section operation.

Power Division

8:30 a.m. Colonial Room

Presiding: John F. Bonner, Member, Exec. Committee, Power Div.

8:30 Taum Sauk Pumped Storage Project

E. A. RUDOLPH, Manager, Taum Sauk Project, Union Electric Co., St. Louis, Mo.

9:00 John Day Lock and Dam—Planning and Site Selection

GLENN H. VON GUNTEN and JOHN F. BRUCE, U. S. Corps of Engrs., Walla Walla, Wash.

9:30 John Day Project—Foundation Investigations

CHARLES J. MONAHAN, U. S. Corps of Engrs., Walla Walla, Wash.

11:00 Flaming Gorge and Glen Canyon Projects

MAX FORD, U. S. Bur. of Reclamation.

Water Resources Joint Session

Sanitary Engineering Div., Waterways and Harbors Div.

8:30 a.m. Council Room

Presiding: J. W. Johnson, Member, Exec. Committee, Waterways and Harbors Div.

8:30 Hydraulic Prototype Tests of McNary Lock Valve

ELLIS B. PICKETT, Hydraulics Div., Waterways Exp. Sta., Vicksburg, Miss.

9:00 Recent Studies of Cyclical Variations in Hydrologic Data

GORDON R. WILLIAMS, Tippetts-Abbett-McCarthy-Stratton Engrs., New York, N.Y.

9:30 Greater Reuse of Reclaimed Waste Waters Through Research

ROBERT C. MERZ, Prof., Civil Eng., Univ. of Southern Calif., and NELSON L. NEMEROW, Prof., Civil Eng., Syracuse Univ., Syracuse, N.Y.

10:00 Water Abstracts—a Proposed Abstracting Journal for Water Resources and Related Subjects

MAURICE L. ALBERTSON, Director, Colo. State Univ. Research Foundation, Fort Collins.

STUDENT AWARDS LUNCHEON

Friday, April 14

12:00 noon Turquoise Room

Presiding: GLENN W. HOLCOMB, President, ASCE

Toastmaster: GENE M. NORDBY, Head, Dept. of Civil Eng., Univ. of Arizona

Presentation of Student Awards: ROGER H. NELSON, Member, ASCE Committee on Student Chapters

All members, guests and friends of the Society are invited to attend.

POST-CONVENTION EXCURSION

Grand Canyon—Glen Canyon Dam Travelcade

Friday through Sunday, April 14-16

The post-convention excursion will be a two-day Grand Canyon-Glen Canyon Travelcade. Grand Canyon is one of the scenic wonders of the world. This titanic gorge is being cut by the second longest river in the United States, the Colorado River. The canyon is located in the high plateau region of northern Arizona.

Glen Canyon, also located on the Colorado River, is the site of Glen Canyon Dam. The dam, now under construction, will be of the concrete arch type. When completed, the structure will be over 500 ft high and 1,500 ft long. The spillways are designed to pass 276,000 cfs of water.

Glen Canyon Bridge, located just downstream of the dam site, is a spectacular rim-to-rim highway; it is the highest (700 ft above the river) and second longest (1,271 ft) steel arch bridge in the United States.

Friday, April 14

4:00 p.m. Leave Hotel Westward Ho, Phoenix

7:00 p.m. Arrive in Flagstaff. Stay all night at Ramada Inn, Flagstaff

Saturday, April 15

7:00 a.m. Leave Flagstaff

10:00 a.m. Arrive Glen Canyon Dam

10:00 a.m. to 2:00 p.m. Inspection of Glen Canyon Dam and lunch.

2:00 p.m. Leave Glen Canyon Dam

5:00 p.m. Arrive at Yavapai Lodge, Grand Canyon

Sunday, April 16

9:00 a.m. Leave Yavapai Lodge for tour of Grand Canyon and Lunch.

2:00 p.m. Leave Grand Canyon

7:00 p.m. Arrive Hotel Westward Ho, Phoenix

Student Activities

Pacific Southwest Council of Student Chapters

TUESDAY, APRIL 11

Interim Committee—Breakfast Meeting

7:00 a.m. Aluminum Room

Presiding: Andrew B. Marum, Chairman, Interim Committee

WEDNESDAY, APRIL 12

Annual Conference of Pacific Southwest Council

4:00 to 6:00 p.m. Saratoga Room

Presiding: Andrew B. Marum, Chairman, Interim Committee

Business Meeting

Open to all members of Arizona, Hawaii, Intermountain, Los Angeles, Sacramento, San Diego and San Francisco Sections.

THURSDAY, APRIL 13

Student Contest Speaker's Orientation Meeting

3:00-4:00 p.m., Aluminum Room, Hotel Westward Ho

Presiding: D. J. Hall, Chairman, Committee on Student Activities, Phoenix Convention, ASCE

Introduction of contest chairmen, explanation of rules and drawing for position

Dinner-Dance

At Phoenix Country Club. All students invited.

FRIDAY, APRIL 14

Student Paper Contest

8:45 a.m.-10:30 p.m.

Pacific Southwest Council Member Schools

Contest A-1 Council Room

Presiding: Terril Ewbank, University of Arizona

Contest A-2 Turquoise Room

Presiding: Kenneth Florian, Associate Contest Member, Tucson

Non-member Schools

Contest B Thunderbird Room

Presiding: Richard Pian, Arizona State University

Finals—Pacific Southwest Council Member Schools

10:30 a.m.-11:45 a.m. Council Room

Presiding: Roger H. Nelson, Committee on Student Chapters

Student Awards Luncheon

12:00 noon Turquoise Room

Details are given in the box for Friday luncheon.

Business Meeting

2:00-3:30 p.m. Colonial Room

Presiding: James Barber, President, Univ. of Arizona Student Chapter, ASCE

Excursion to Glen Canyon Dam and Grand Canyon

4:00 p.m. Friday, April 14 to 7:00 p.m. Sunday, April 16

UNIVERSITY OF ARIZONA ALUMNI BREAKFAST

Alumni of the University of Arizona will meet for breakfast at 7:00 a.m., Thursday, April 13, in the Colonial Room of the Westward Ho.

All alumni of the U. of A. are cordially invited to attend.

LADIES ACTIVITIES

Monday, April 10

9:00 to 5:30 p.m. Hospitality Room (Patio suite at pool side), Headquarters Hotel

12:30 p.m. General Membership Luncheon
Thunderbird Room, Headquarters Hotel
Senator Barry Goldwater, speaker

6:30 to 7:30 p.m. Ice Breaker
Headquarters Hotel

Tuesday, April 11

9:00 to 5:30 p.m. Hospitality Room

12:20 p.m. Luncheon and Style Show
Styles by internationally known designer featuring Western attire.

6:30 p.m. Barbecue and Western Party

Wednesday, April 12

9:00 to 5:30 p.m. Hospitality Room

10:00 a.m. to 3:00 p.m. Shopping Spree in the West's most Western town, Scottsdale.

Thursday, April 13

9:00 to 5:30 p.m. Hospitality Room

10:00 a.m. to 2:30 p.m. Busses for Taliesin West Tour (Frank Lloyd Wright's Home and Studio) and Luncheon at the Arizona Country Club

6:30 p.m. Informal Dinner Dance Phoenix Country Club

Friday, April 14

9:00 to 12:00 noon, Hospitality Room

4:00 p.m. Post-Convention trip to Grand Canyon and Glen Canyon

1961 PHOENIX CONVENTION COMMITTEE

Elmer J. Maggi, *General Chairman*
Hubert H. Brown, Dwight L. Busby, Glenn C. Bush, Robert M. Cushing, James H. Deatherage, Leigh O. Gardner, William I. Tizard, Edmund J. Waltenspiel, Clarence H. Whalin, Jake T. Doss.

COMMITTEE CHAIRMEN

Carl H. Billings, *Printing*
Carlie Bowmer, *Attendance Promotion*
David J. Hall, *Student Activities*
Quinn L. Hutchinson, *Special Projects*
James D. King, *Hotel Arrangements*
Marvin E. Larson, *Registration*
Peggi Maggi, *Ladies Activities*
John C. Park, *Conditions of Practice Program*
Paul F. Ruff, *Excursions*
John H. Tanner, *Hospitality*
Julian J. Turner, *Publicity and Public Relations*
Arthur F. Vondrick, *Luncheons*
Kenneth D. Voyles, *Entertainment*
George E. Wilbur, *Exhibits*
Hanen H. Williams, *Technical Program*

THE READERS WRITE

Factor of safety for concrete-pipe sewers

TO THE EDITOR: Changes in ASCE Manual 37, "Design and Construction of Sanitary and Storm Sewers," were announced in the July 1960 issue, p. 79. In a letter to the editor in the October 1960 issue, p. 108, Prof. M. G. Spangler of Iowa State University took exception to changes involving the factor of safety to be used in the design of reinforced-concrete pipe sewers. The editing committee answered Professor Spangler's objections in a letter to the editor in the December 1960 issue, p. 75.

Professor Spangler and the editing committee are in agreement on at least one point. Professor Spangler states, "This crack width (0.01-in. crack) has also gained wide favor as the limiting value that should not be exceeded in the design of pipe installations"; and the editing committee replied, "We certainly agree that the design working strength should never exceed the 0.01-in. pipe strength for any pipe."

But should the design working strength even approach the 0.01-in. crack strength when designing sanitary sewers? Might this not result in a cracked sewer installation, thus exposing the reinforcing steel to sewer gases and acids? This possibility can be eliminated by applying the safety factor to the 0.01-in. crack strength rather than to the ultimate strength.

JOHN B. POWERS, F. ASCE
Engineering Representative
W. S. Dickey Clay Mfg. Co.
Texarkana, Tex.

A general stepped-beam deflection formula

TO THE EDITOR: Prof. T. F. Hickerson is to be commended for his work and his letter on the determination of stepped-beam deflections (November 1960 issue, p. 76). It appears pertinent, however, to mention that his claim for the simplicity of the conjugate-beam procedure does not seem to be fully borne out in practice.

A perusal of his letter reveals the following conditions which limit his method: (1) a long-table exposition for only a special case, (2) oversimplified restriction to the particular stepping pattern at midspan, (3) finite segmentation of continuous functions integrable within limits —approximate instead of exact, (4) many one-figure and two-figure tabular values incapable of giving the usual three-figure accuracy, (5) limitation to a 20-ft beam entailing further modification for any other span length, (6) unavoidable additional calculation if the point of deflection sought is off each 1-ft point, (7) inapplicability of the table when the stepping point is anywhere else than at midspan, and (8) leaving readers without a clue as to how to calculate the deflection at any point for a stepped variation at any location along the span.

Professor Hickerson's procedure could have been boiled down to the simple statement that the moment due to the elastic weight about any point gives the deflection at that point.

A general solution that is much easier to apply can be evolved from one of Castigliano's theorems (1873). With the origin at A and notations as shown in the accompanying Fig. 1, let

y = deflection at any point, P
s = any distance along AB from A
$M = (W/2)\ (L - s)\ s$ = moment of loading and its reactions

$\frac{\partial M_0}{\partial F_0} = (1 - \frac{X}{L})\, s$ = derivative of moment due to $F_0 = 0$ at P with respect to F_0 for $0 \lesssim s \lesssim x$

$\frac{\partial M_0'}{\partial F_0} = x\,(1 - \frac{S}{L})$ for $x \lesssim s \lesssim L$

U = total internal strain energy

When $0 \lesssim x \lesssim l$, the mathematico-elastic formulation for y is

$$y = \frac{\partial U}{\partial F_0} = \frac{1}{EI}\left[\frac{1}{r}\left(\int_0^x M\frac{\partial M_0}{\partial F_0}\,ds + \int_x^l M\frac{\partial M_0'}{\partial F_0}\,ds\right) + \int_l^L M\frac{\partial M_0'}{\partial F_0}\,ds\right]$$

whence $y = C\,x\left[K - \frac{Lx^2}{r}\,(2L - x)\right]$ . . . . . (1)

where $C = \frac{w}{24\,EI\,L}$

$K = 6\,L^2(L^2 - Rl^2) - 8\,L\,(L^3 - Rl^3) + 3\,(L^4 - Rl^4)$

and $R = 1 - \frac{1}{r}$

When $l \lesssim x \lesssim L$, use the same formula for y, but take the origin at B and change r to $1/r$, instead of deriving another equation.

In Hickerson's special case, $l = L/2$, $r = 2$, $y_e = \frac{5\ wL^4}{512\ EI}$; and for constant I throughout, $r = l$, $y_e = \frac{5\ wL^4}{384\ EI}$, as it should be.

Equation 1 applies to the calculation of y for x from A to D and from B to D by any means—abacus, slide rule, desk calculator, or electronic computer. For speedier numerical computation in arrays, using Cayley's matrix multiplication (1857), we have, with C as before,

$$y = C\left[x,\ x^3,\ x^4\right]\left\{K,\ -\frac{2\,L^2}{r},\ \frac{L}{r}\right\} \quad . \quad (2)$$

in which

$$K = \left[6\,L^2,\ -8\,L,\ 3\right]\begin{bmatrix} L^2 & l^2 \\ L^3 & l^3 \\ L^4 & l^4 \end{bmatrix}\begin{bmatrix} 1 \\ \frac{1}{r} \\ -1 \end{bmatrix}$$

It is to be noted that, by setting ingenious classical methods to work, many an even knottier problem can be solved more elegantly and expeditiously than by a conventional approach.

SHU-T'IEN LI, F. ASCE
Formerly Dean, College of Eng., Peiyang Univ.
Mobile, Ala.

ASCE NEWS

Hoover Medal Awarded to President Eisenhower

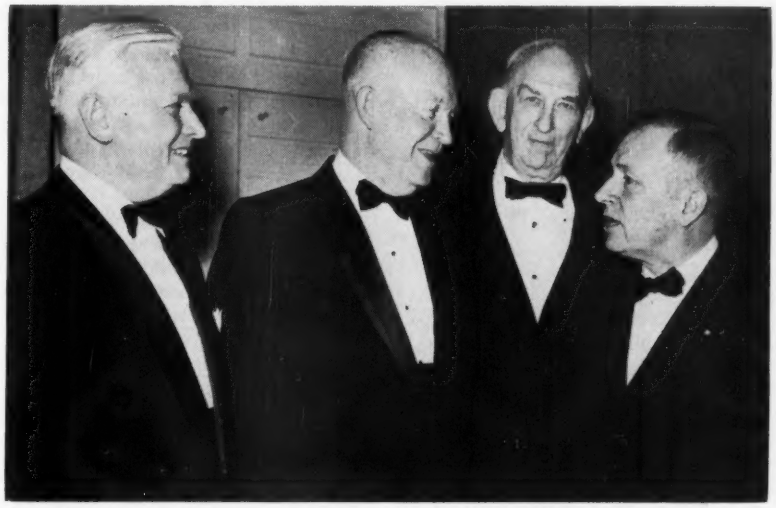
In one of his last public appearances as President, Dwight D. Eisenhower was awarded the Hoover Medal at a dinner held in Washington, D.C., on January 10. Mr. Eisenhower is the second President of the United States to receive the medal, which is sponsored by the four original Founder Societies. Herbert Hoover, Hon. M. ASCE, in whose honor the medal was established, was its first recipient in 1930. Other distinguished recipients of the award include the late Ambrose Swasey, Gano Dunn, and Charles F. Kettering, all Honorary Members of ASCE.

Presentation of the award to the President was made by Walker L. Cisler, president of the Detroit Edison Company, president of the American Society of Mechanical Engineers, and chairman of the Hoover Medal Board of Award.

The citation accompanying the President's award reads: "History records the leadership in world peace which Dwight David Eisenhower has given to all people in preparing and directing undertakings of monumental engineering dimensions in military and civilian operations of great magnitude and far-reaching significance. As organizer, leader, and our President, he has throughout his illustrious career given proof of the importance of the individual by the impact of his actions in building a better world for people everywhere."

Featured speaker at the dinner was S. L. A. Marshall, Brigadier General (retired), U.S. Army. General Marshall, who was historian of a number of the major military activities of World War II, is now a military critic and editorial writer for the *Detroit News*. Speaking on the topic, "The Engineering Victory of the European Theater of Operations," General Marshall recalled the enormity of the task facing General Eisenhower in the war years.

"To dig the Panama Canal and free it of rockslides over many years," said General Marshall, "required the movement of 72,306,000 tons of earth. This was localized displacement, steam shovels picking it up here and laying it down there. To operate the European Theater through one year of war on the continent, and to stage invasion from the United Kingdom, entailed the movement of 73,737,680 long tons, most of it transported across oceans and narrow seas, amid peril. Roughly two-thirds of this tonnage went from America to continental ports and from there had to be disposed forward by the command over roads in disrepair, railways at first non-operable and pipelines initially non-existent."



Viewed at Hoover Medal presentation dinner, held in Washington on January 10, are Walker L. Cisler, chairman of the Hoover Medal Board of Award, who made the presentation; President Eisenhower, recipient of the medal; ASCE Past President R.E. Dougherty; and Brig. Gen. S.L.A. Marshall, featured speaker.

To give a further idea of the vast engineering operations involved in the invasion, General Marshall recalled that, "There was no thoroughfare anywhere leading across France in the hour when Normandy was breached. To provide a path for the armies and reunify the tissues of civilian Free Europe's workaday existence, 223 major highway bridges had to be reconstructed or replaced. More than 500 other bridges required repairs and maintenance. By late January 1945, 2,100 miles of highway had to be given special engineering attention because of the original damage, compounded by the winter freeze and thaw. Overall, 7,476 miles of highway fell within the military network to be supervised and maintained by its engineers."

The attendance of over 400 included ASCE Past Presidents R. E. Dougherty, Francis S. Friel, and Gail A. Hathaway. Executive Secretary William H. Wisely represented President Holcomb at the ceremonies.

Hawaii Section Plans Post-Convention Program

The Hawaii Section has arranged an interesting two-day meeting for April 20 and 21, to which all Phoenix Convention visitors are cordially invited. The meeting place will be the Princess Kaiulani Hotel, Waikiki, Honolulu. Technical sessions—scheduled for both the morning and afternoon of April 20 and the morning of April 21—will center about the theme, "New Developments in Structural Design." Speakers already lined up include Walter Kunze, manager of the Structural Bureau of the Portland Cement Association, Chicago; Edward Rice, of T. Y. Lin & Associates; and Dr. Stephen Mewadowski, consultant.

Luncheon on the 20th will feature an address by the Governor of Hawaii, and the President's Cocktail Party is set for 6:30 that evening. Following noon luncheon on the 21st, the group will take off on a field trip. A banquet at 7:00 p.m. will conclude the program.

Follow-up to Conference on Engineering Education

Progress is reported in the follow-up stage of the 1960 Conference on Civil Engineering Education, held at Ann Arbor, Mich., last July. The ASCE Committee on Engineering Education has assumed post-conference responsibilities, as part of a continuing program of study that ASCE President Glenn W. Holcomb has declared "essential to the establishment of guidelines for improving the civil engineering curriculum." President Holcomb has asked the committee to spearhead any future action that may be indicated by a projected vote on the conference resolutions and the results of an opinion survey to be conducted by the committee.

Balloting on the conference resolutions and publication of the conference Proceedings are scheduled for late February. Each registrant at the conference will receive a complimentary copy of the Proceedings. A nominal charge of $1.00 will be made for additional copies. Requests should be sent to Society headquarters with covering checks or money orders.

Ballots and opinion survey questionnaires will be mailed with the Proceedings in accord with the following plan:

1. Each official delegate will receive a ballot listing the conference resolutions. It is intended that the official delegate should vote in accordance with his own beliefs rather than as a representative of his institution. He may, if he prefers, vote anonymously.

2. The head of each ECPD-accredited civil engineering department will receive a ballot on the conference resolutions. It is intended that each department should study and discuss the conference papers and register its departmental vote on the resolutions. These ballots, too, may be submitted anonymously, but provision will be made for identification of the institutions that wish to "stand up and be counted."

3. Non-delegate conferees who are not members of civil engineering departments will receive unofficial individual ballots. These participants in the conference are urged to vote, and may do so anonymously if they prefer.

The conference resolutions will be presented for vote in the exact wording accepted for publication at the final meeting in Ann Arbor. The Committee's opinion survey is based on an analysis of the basic criteria that comprise the conference resolutions, and a breakdown of the principal elements contained in comments submitted by conference registrants.

Results of the voting will be analyzed by a group consisting of the ASCE Committee on Engineering Education and civil engineering representatives from the following organizations: (1) the Conference Planning Committee; (2) the ASEE Committee on Evaluation of Engineering Education; (3) the ASEE Civil Engineering Division; (4) the ASCE Task Committee on Professional Education; and (5) the ECPD Education and Accreditation Committee.

The Committee on Engineering Education urges that each participant give this matter the top-priority rating it so obviously deserves. A good return of ballots and questionnaires is essential to the validity of the conclusions to be drawn as to the future of civil engineering education.

ASCE ENGINEERING SALARY INDEX

(Prepared Semiannually)

Consulting Firms

City	Current	Previous
Atlanta	1.38	1.21
Baltimore	1.14	1.14
Boston	1.23	1.23
Chicago	1.50	1.49
Denver	1.25	1.25
Houston	1.26	1.26
Kansas City	1.19	1.15
Los Angeles	1.35	1.32
Miami	1.38	1.38
New Orleans	1.22	1.22
New York	1.29	1.29
Pittsburgh	1.07	1.07
Portland (Ore.)	1.28	1.24
San Francisco	1.35	1.34
Seattle	1.13	1.06

Highway Departments

Region	Current	Previous
I, New England	1.03	1.03
II, Mid Atlantic	1.15	1.15
III, Mid West	1.26	1.29
IV, South	1.12	1.12
V, West	1.13	1.16
VI, Far West	1.16	1.17

Sole purpose of this Index is to show salary trends. It is not a recommended salary scale. Nor is it intended as a precise measure of salary changes. The Index is computed by dividing the current total of base entrance salaries for ASCE Grades I, II and III by an arbitrary base. The base used is $15,930, the total of salaries paid in 1956 for Federal Grades GS5, GS7 and GS9. Index figures are adjusted semiannually and published monthly in CIVIL ENGINEERING. Latest survey was December 31, 1960.

ASCE Membership as of January 9, 1961

Fellows	11,212
Members	16,328
Associate Members	19,240
Affiliate Members	115
Honorary Members	47
Total	46,942
(January 9, 1960	44,593)

Engineering Specialty Board To Hold Examinations

The next qualifying examination of the American Sanitary Engineering Intersociety Board will be held on May 18, 1961. The examination will be in three parts: one dealing with basic engineering sciences, a second dealing with the specialty area selected by the applicant, and the third an oral examination. The specialty areas recognized by the Board are: air pollution control; industrial hygiene; public health; radiation hygiene and hazard control; and water supply and waste water disposal.

Applications for admission to the examination must be received by April 1, 1961. Forms for applying may be obtained from the American Sanitary Engineering Intersociety Board, Inc., 33 West 39th St., New York 18, N.Y.

Each person certified becomes a Diplomate of the American Academy of Sanitary Engineers. There were 1,036 Diplomates listed in the Academy on December 31. Requirements for certification include good moral and professional character, graduation with a degree in engineering from an acceptable institution, registration as a professional engineer in the United States or Canada, eight years of professional sanitary engineering work (with at least four of them in responsible charge of work), and satisfactory completion of a written and oral examination.

The American Sanitary Engineering Intersociety Board was organized several years ago to improve the practice of sanitary engineering. Sponsors, in addition to ASCE, are the American Institute of Chemical Engineers; the American Public Health Association; the American Society for Engineering Education; the American Water Works Association; and the Water Pollution Control Federation.

New Officers for Host Section to Phoenix Convention

Arizona Section will be host to the ASCE Spring Convention under a new slate of officers, elected at a late fall meeting in Phoenix. Seated, left to right, are Edward C. Fraedrich, newly elected president, and Wayne G. O'Harra, Phoenix, ASCE Director for District 11. Standing, in same order, are Andrew B. Marum, retiring Section president, and Trent R. Dames, Los Angeles, ASCE Director for District 11. The elaborate program being planned for the Phoenix Convention by hard-working Arizona Section committees is printed in this issue.

The Society's UEC Campaign Statistics as of December 31, 1960

Local Section	Quota	Contributions		
		Number	Amount*	% Quota
ZONE I	$197,300	2,546	$223,655	113
District 1	133,000	1,335	152,815	114
Brazil	2,100	10	353	20
Metropolitan	119,200	1,149	143,937	120
Panama	1,300	47	1,258	97
Puerto Rico	3,100	58	3,583	115
Rep. of Colombia	2,400	9	474	20
Venezuelan	5,200	62	3,210	62
District 2	43,400	818	45,584	105
Connecticut	11,000	183	12,121	110
Maine	4,700	103	4,907	104
Massachusetts	23,000	426	24,204	105
New Hampshire	1,800	45	1,296	72
Rhode Island	2,900	58	2,981	103
District 3	20,600	393	22,756	110
Buffalo	4,400	99	4,555	103
Ithaca	2,400	52	3,488	145
Mohawk-Hudson	7,500	94	6,104	81
Rochester	1,900	42	2,373	125
Syracuse	4,400	84	4,841	110
ZONE II	169,700	3,595	169,184	99
District 4	34,000	712	47,036	138
Delaware	4,100	128	4,553	111
Lehigh Valley	4,200	104	5,733	137
Philadelphia	20,000	297	30,523	152
Central Pa.	5,700	183	6,227	109
District 5	27,000	686	21,581	80
National Capital	27,000	686	21,581	80
District 6	49,000	970	52,815	108
Maryland	15,000	364	16,413	109
Pittsburgh	17,000	336	17,778	104
Virginia	13,300	225	13,374	101
West Virginia	3,700	45	5,250	142
District 10	58,700	1,227	45,252	76
Alabama	8,900	159	5,270	59
Florida	11,500	77	4,324	38
Georgia	10,400	226	11,438	110
Nashville	2,700	57	2,778	103
North Carolina	6,300	76	4,440	71
South Carolina	5,500	120	3,346	61
South Florida	5,200	56	3,454	66
Tennessee Valley	9,200	456	10,202	111
ZONE III	202,200	4,132	190,180	94
District 7	39,900	777	28,180	71
Duluth	1,500	47	1,523	102
Michigan	18,000	253	9,324	52
Northwestern	8,000	134	4,882	61
Wisconsin	10,700	308	11,389	106
South Dakota	1,700	35	932	54
District 8	37,100	626	39,380	106
Central Illinois	6,500	151	7,098	109
Illinois	29,000	397	30,391	105
Tri-City	1,600	78	1,891	118
District 9	45,700	1,030	51,522	112
Akron	3,100	72	2,331	75
Central Ohio	5,100	172	5,517	108
Cincinnati	4,700	129	6,735	143
Cleveland	9,300	119	9,369	101
Dayton	3,300	39	2,314	70
Indiana	11,000	317	15,476	141
Kentucky	6,100	129	7,561	124
Toledo	3,100	53	2,219	71
District 14	31,500	568	24,882	79
Mid-Missouri	3,500	115	2,855	81
Mid-South	11,000	149	7,454	68
Oklahoma	6,900	124	5,707	83
St. Louis	10,100	180	8,866	88
District 16	48,000	1,131	43,716	91
Colorado	13,900	198	7,571	55
Iowa	5,900	148	6,257	106
Kansas City	12,000	355	14,288	119
Kansas	7,600	220	6,436	85
Nebraska	6,300	152	6,725	107
Wyoming	2,300	58	2,439	105
ZONE IV	230,800	4,903	239,686	103
District 11	132,600	2,932	138,763	104
Arizona	5,000	157	5,590	111
Hawaii	6,300	250	8,173	130
Intermountain	4,700	117	4,821	103
Los Angeles	50,200	950	55,671	110
Sacramento	16,300	531	15,750	97
San Diego	6,000	113	3,966	66
San Francisco	44,100	814	44,792	101
District 12	40,400	1,044	41,951	103
Alaska	2,200	32	2,389	109
Columbia	2,200	82	3,011	137
Montana	3,300	97	3,339	101
Oregon	10,900	254	8,530	78
Seattle	12,200	294	12,278	100
Southern Idaho	2,300	79	4,635	201
Spokane	3,100	84	3,151	101
Tacoma	4,200	114	4,233	101
District 15	57,800	927	56,472	97
Louisiana	13,000	117	13,183	101
Mexico	1,400	24	993	71
New Mexico	4,000	53	2,486	62
Texas	39,400	733	39,810	101
TOTAL	$800,000	15,176	$822,705	103

*Total of Local Section contributions do not reconcile with District and Zone totals because (*a*) some pledges were requested to be distributed directly to Zones, and (*b*) pledges of Canadian members are assigned directly to certain Districts.

For carrying corrosive drainage..... THIS

YOU MORE SERVICE...

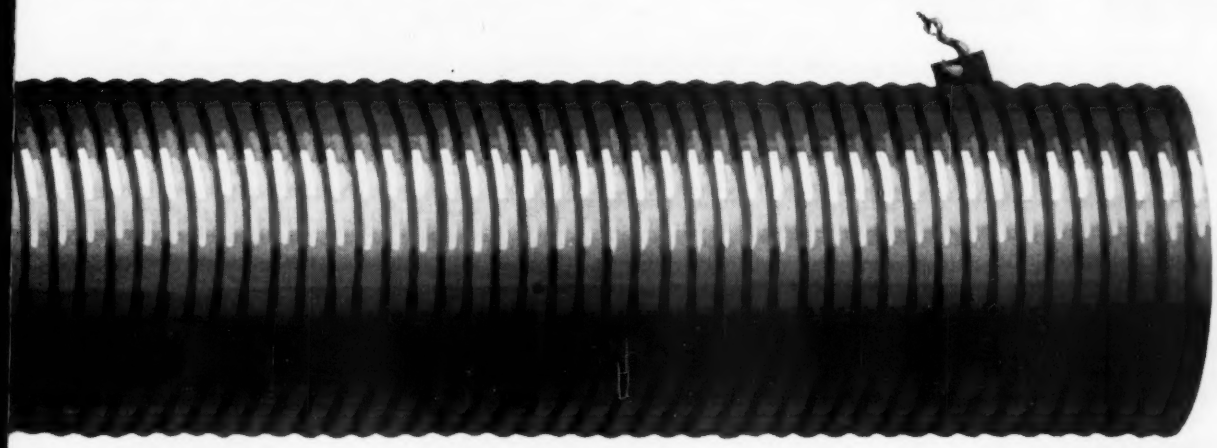
THAN ANY

Artist's drawing shows ASBESTOS-BONDED in cross section.

Steel

. . . for durability, strength, economy

ARMCO PIPE WILL GIVE DOLLAR FOR DOLLAR...
OTHER PIPE YOU CAN BUY



New steels are born at Armco

The Pipe is Armco ASBESTOS-BONDED®, a corrugated metal drainage pipe with unique corrosion resistant properties. Durable, inert asbestos fibers are imbedded in the zinc coating on the steel pipe while the zinc is still molten. Then a sealer-saturant is applied. The result is the most durable drainage structure known. Dollar for dollar, Armco ASBESTOS-BONDED will outlast . . . materially *and* structurally . . . any other pipe you can buy. Our customers have proved it!

Armco ASBESTOS-BONDED Pipe is one of a complete family of service-proved drainage products. Let us send you a copy of the latest catalog of Armco Sewer Structures or Armco Corrugated Metal Pipe (check one or both in coupon). Armco Drainage & Metal Products, Inc., 4481 Curtis Street, Middletown, Ohio.

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☐ Send catalog of Armco Sewer Structures (CMS-7458)
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ARMCO Drainage & Metal Products

Daniel W. Mead Prize Winners for 1960

During its Boston meetings in October the Board of Direction approved the award of the 1960 Daniel W. Mead Prizes to James M. Abernathey, winner of the Associate Member Prize, and Jack K. Keiser, winner of the student prize. Another student prize, consisting of a second order of merit, was awarded to Clayton A. Stimmel. All wrote on the same subject, "Under What Conditions May an Employee Do Engineering Work Outside His Normal Employment?"

J. M. Abernathey

Jack W. Keiser

Mr. Abernathey, a resident of Bellaire, Tex., is a civil engineer with the Houston firm of Brown & Root. His work consists of the design of marine and ship-handling facilities, offshore structures for the petroleum industry, and the preparation of engineering studies and reports. He is a 1958 graduate of the University of Texas and a member of the Houston Branch of the Texas Section.

Jack W. Keiser was active in the ASCE Student Chapter at Stanford University, from which he graduated last June. In May 1960 he tied for second place in the student paper contest at the Pacific Southwest District Conference of Student Chapters. Enlisting in the Navy, he graduated from the Civil Engineer Corps Officers School at Port Hueneme, Calif., in December 1960, and is currently stationed in the Public Works Department of the Naval Air Station at Olathe, Kans. He has the rank of ensign. In December the Stanford Student Chapter and Civil Engineering Department flew him to San Francisco to attend a Chapter meeting dedicated to him.

Presentation of the awards to Messrs. Abernathey and Keiser will take place at their convenience at some early Society or Section meeting.

The Mead Prizes, which were established and endowed by the late Daniel W. Mead, Past President and Honorary Member of ASCE, consist of $100 and an engraved certificate for the Associate Member winner and $50 and a certificate for the student winner. As announced in the January issue (page 72), the rules governing award of the prizes have been liberalized to permit contestants to write on any civil engineering subject, though preference will be given to outstanding papers on professional ethics. In the past contestants wrote on a set topic determined by the Committee on Professional Conduct.

New Closing Date for Daniel W. Mead Prizes

The closing date for the Daniel W. Mead Prizes has been changed from May 1 to June 1 in order to provide more time for the various procedures required before the papers selected in preliminary competition must be mailed to Society headquarters. A number of other rules governing the award of the Mead Prizes have been revised (January issue, page 72).

SOCIETY AWARDS AND FELLOWSHIPS AVAILABLE

DANIEL W. MEAD PRIZES: *1961 contest closes June 1, 1961. See 1960 Official Register, page 149, and January 1961 CIVIL ENGINEERING, page 72.*

FREEMAN FELLOWSHIP: *1961 contest closes March 1, 1961. See Official Register, page 154.*

J. WALDO SMITH HYDRAULIC FELLOWSHIP: *1961-62 contest closes April 1, 1961. See Official Register, page 156.*

RESEARCH FELLOWSHIP: *1961 contest closed. New contest closes Jan. 1, 1962.*

Professional Survey of Engineers in Industry

Engineers in industry apparently tend to underrate their professional status—a view not shared by industrial management; over 60 percent of the engineers employed in industry think there is considerable malutilization of engineers, but only 30 percent of industrial managers agree; more than half the engineers in industry think that higher pay would advance the engineering profession, but only 20 percent of industrial managers agree.

These are some of the findings reported in a survey entitled "Engineering Professionalism in Industry," sponsored by the Professional Engineers Conference Board for Industry, in cooperation with the National Society of Professional Engineers. The primary objective of the study was to find out what engineers and engineering managers mean by professionalism, and how they think it can best be advanced.

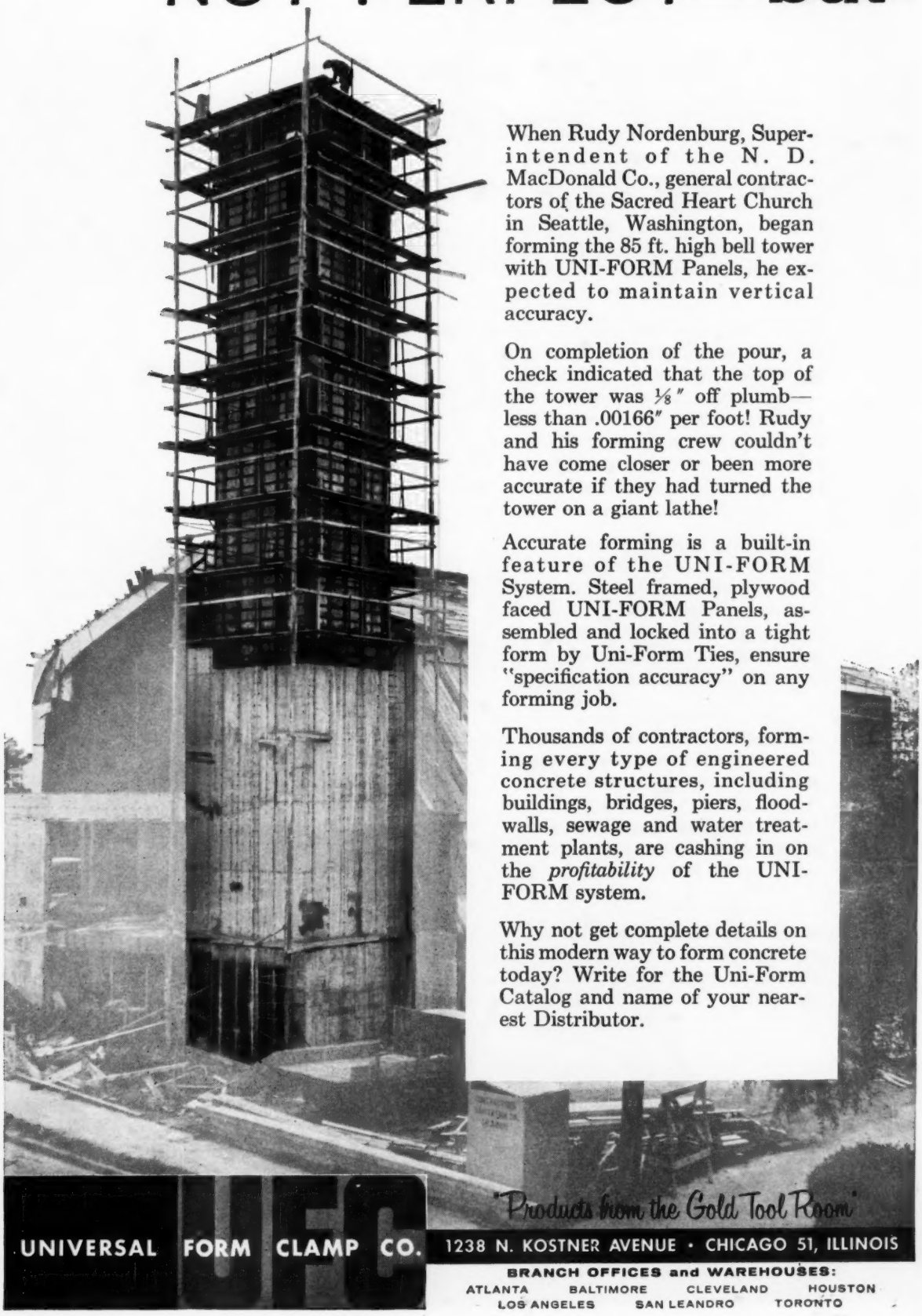
The survey, the sixth in a series for the Conference Board, is now available in booklet form from the National Society of Professional Engineers, 2029 K Street, N.W., Washington 6, D. C.

Column Research Council Guide to Metal Members

Publication of a *Guide to Design Criteria for Metal Compression Members* is announced by the Column Research Council of Engineering Foundation. The 112-page reference presents a summary of design criteria based upon recent as well as past research on metal compression members in buildings and bridges. It is directed particularly to the engineer who has special problems not covered by standard specifications or who is himself engaged in the preparation of specifications for such structures.

Areas covered include centrally located columns, compression member details, laterally unsupported beams, and beam-columns. Construction metals under ASTM Specifications are also covered, including the new ASTM A36 Structural Carbon Steel. The volume, in leatherette binding, sells for $5.00. Orders should be addressed to the Secretary, Column Research Council, 313 West Engineering, University of Michigan, Ann Arbor, Mich.

NOT PERFECT—**but**



When Rudy Nordenburg, Superintendent of the N. D. MacDonald Co., general contractors of the Sacred Heart Church in Seattle, Washington, began forming the 85 ft. high bell tower with UNI-FORM Panels, he expected to maintain vertical accuracy.

On completion of the pour, a check indicated that the top of the tower was ⅛″ off plumb—less than .00166″ per foot! Rudy and his forming crew couldn't have come closer or been more accurate if they had turned the tower on a giant lathe!

Accurate forming is a built-in feature of the UNI-FORM System. Steel framed, plywood faced UNI-FORM Panels, assembled and locked into a tight form by Uni-Form Ties, ensure "specification accuracy" on any forming job.

Thousands of contractors, forming every type of engineered concrete structures, including buildings, bridges, piers, floodwalls, sewage and water treatment plants, are cashing in on the *profitability* of the UNI-FORM system.

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BRANCH OFFICES and WAREHOUSES:
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LOS ANGELES SAN LEANDRO TORONTO

Rugged pipe installs easily –even in a soggy bed

This 30″ cast iron pipe was installed for expansion of a water system in Memphis, Tennessee.

Despite heavy rains, the pipe went right to bed in wet trenches. Upon completion, the mains were tested at 150 psi for 12 hours and were found to be bottle-tight.

Cement-lined cast iron pipe prevents pipe-clogging . . . always delivers a full flow of water. Bottle-tight joints are tight enough to resist hundreds of pounds of pressure per square inch . . . yet flexible enough to permit deflection both during and after installation.

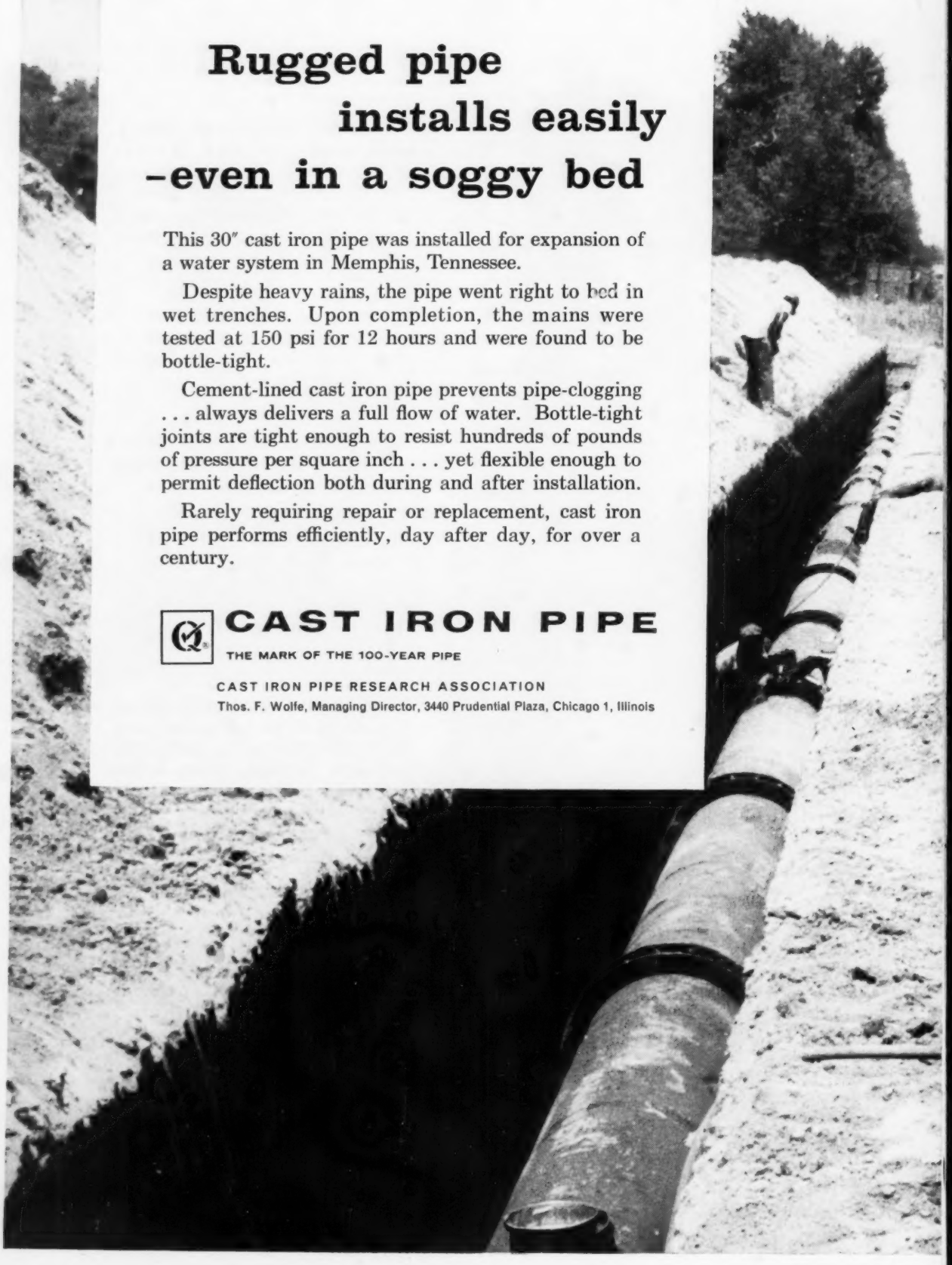
Rarely requiring repair or replacement, cast iron pipe performs efficiently, day after day, for over a century.

CAST IRON PIPE

THE MARK OF THE 100-YEAR PIPE

CAST IRON PIPE RESEARCH ASSOCIATION

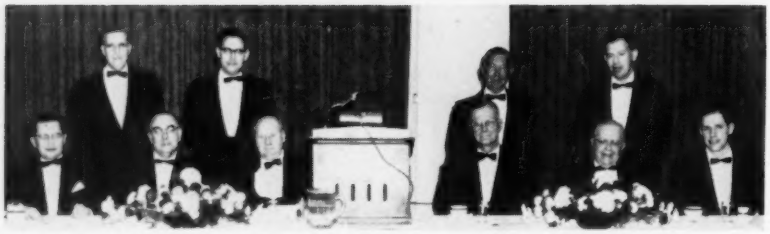
Thos. F. Wolfe, Managing Director, 3440 Prudential Plaza, Chicago 1, Illinois



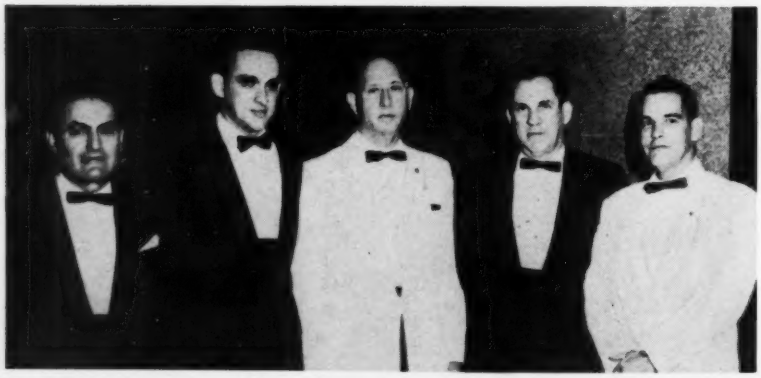
NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

Four University of Washington civil engineering students received Richard Williamson Jones Memorial awards at recent meeting of the Seattle Section. Mrs. Jones, who established the memorial to her husband, presents cash awards of $500 each to (front row) Roy R. Zachary, Richard M. Allen, (back row) James L. Mahlik, and Robert L. Brandon.



Seated at the head table at the annual dinner of the St. Louis Section, held December 2, are (left to right) W. J. Hedley, Vice President, Zone III; Earl Salveter, president-elect; Irvin Mattich, guest speaker; E. E. Bloss, retiring president; Vern Hanna, past-president; and Jim Paul, treasurer-elect. Standing in same order are John Leslie, second vice president-elect; Irwin Benjamin, secretary; Ralph Eason, first vice president-elect; and Jay Lapin, retiring treasurer. During the program William Judson Gray (not shown) received a Life Membership Certificate.



Highlight of the December 10th meeting of the Puerto Rico Section was the installation of the 1961 officers. In usual order are Pedro Colon Pagan, second vice president; Juan R. Figueroa, first vice president; Fernando Torrent, president; Hector A. Deliz, past-president; and Sivan F. Van Derdys, secretary-treasurer. Earlier, Frank L. Porrata Doria was presented with a Life Membership Certificate.

ASCE CONVENTIONS

PHOENIX CONVENTION
Phoenix, Ariz.
Hotel Westward Ho
April 10-14, 1961

ANNUAL CONVENTION
New York, N. Y.
Hotel Statler
October 16-20, 1961

HOUSTON CONVENTION
Houston, Tex.
Hotel Shamrock
February 19-23, 1962

TECHNICAL DIVISION MEETINGS

CONFERENCE ON ENVIRONMENTAL SANITATION AND URBAN PLANNING
Evanston, Ill.
Northwestern Technological Institute
March 21-22, 1961
Sponsored by
Sanitary Engineering Division
City Planning Division

AIR TRANSPORT CONFERENCE
Miami Beach, Fla.
Carillon Hotel
May 11 and 12, 1961
Sponsored by
Air Transport Division
Airport Operators Council

SYMPOSIUM ON WATER RESOURCES AND RECLAMATION
Fort Collins, Colo.
Colorado State University
June 12-15, 1961
Sponsored by
U.S. Bureau of Reclamation
Colorado State University
ASCE

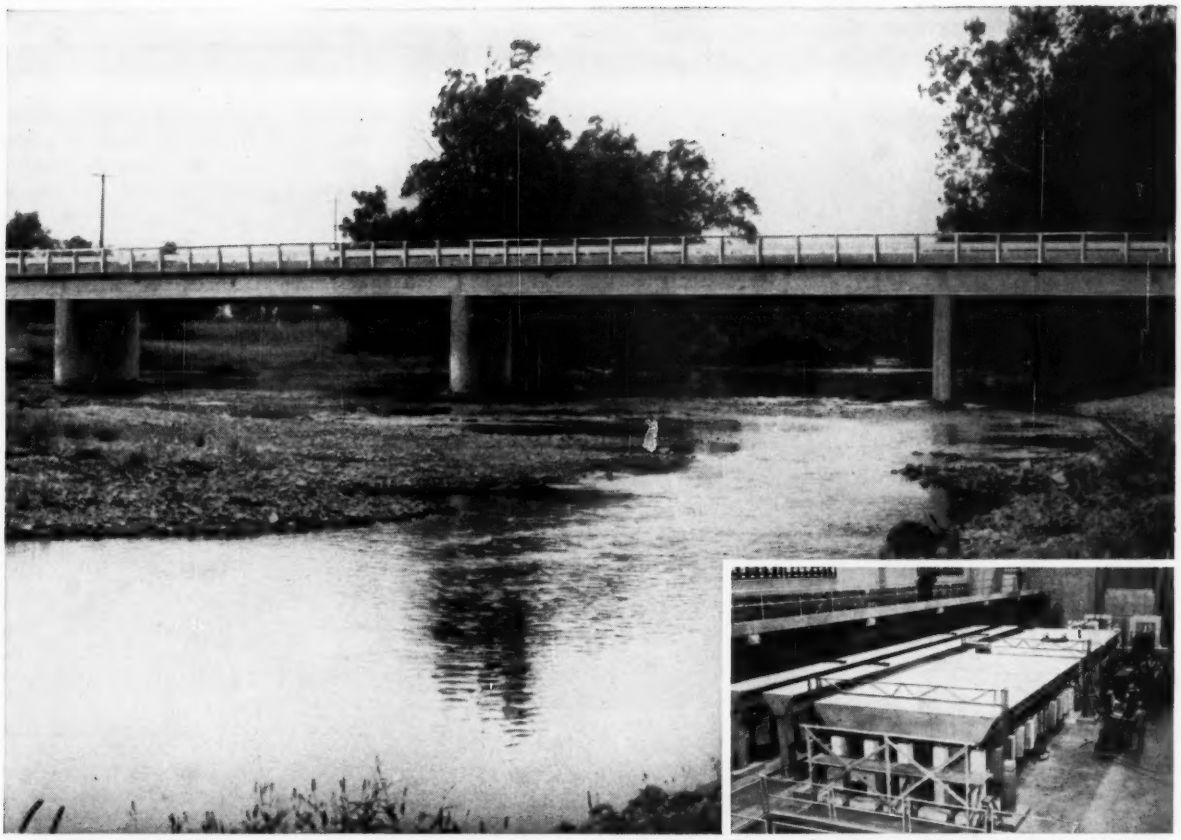
HYDRAULICS DIVISION CONFERENCE
Urbana, Ill.
University of Illinois
August 16-18, 1961
Sponsored by
Hydraulics Division

DISTRICT CONFERENCES

NEW ENGLAND COUNCIL
Boston, Mass.
Massachusetts Institute of Technology
March 25, 1961

PACIFIC SOUTHWEST COUNCIL
Phoenix, Ariz.
Hotel Westward Ho
April 10-14, 1961

PACIFIC NORTHWEST COUNCIL
Spokane, Wash.
April 21-22, 1961



The recently completed bridge over the Scioto River in Delaware County, Ohio, has four spans: 71 ft—82 ft—82 ft—71 ft. Beams are precast, pretensioned AASHO-PCI Type IV, spaced 7' 6" center to center. Design Live Load is Ohio C130 (57) which is comparable to AASHO H15-12. Contractor: Wander and Mason Corp., Worthington, Ohio. Designed by: Ohio Dept. of Highways under supervision of D. Henry Overman, Engineer of Bridges. **Fabricator of Prestressed Concrete Members: Great Lakes Structural Products, Toledo, Ohio.**

The use of continuity achieved with reinforcing bars in the slab, and the elimination of end blocks, were both based on a test program on prestressed concrete bridges begun in 1957 by Portland Cement Association's Research and Development Laboratories. Each of these items is a definite step towards greater economy in prestressed bridges.

Continuity in deck slab improves efficiency of prestressed

SCIOTO RIVER BRIDGE

In building the multiple span Scioto River Bridge on State Route 37, Delaware County, Ohio, highway engineers used a new method by which the existing economy and efficiency of standard precast and prestressed beams were even further enhanced.

The difference in fabrication and erection by the new method involves a modification to provide full depth diaphragms at supports, additional reinforcing steel in the slab over the supports and elimination of end blocks in the precast beams. The structure is thus made continuous for live load.

The advantages are several. For example: continuity distributes moments more evenly over the span. A smaller beam section can be used, while capacity is calculated to be even greater. Less prestressing steel is needed, and fewer joints mean less maintenance. Riding surfaces are smoother.

Roebling has long been active in fostering prestressed concrete construction, and has gathered a wealth of material and experience dealing with its every phase. This includes design data information, fabricating methods and, of course, the manufacture of the finest prestressing materials available. For information on prestressed concrete contact your nearby fabricator or Roebling's Construction Materials Division, Trenton 2, N. J.

ROEBLING

Branch Offices in Principal Cities
John A. Roebling's Sons Division
The Colorado Fuel and Iron Corporation

Leo V. Campbell (second from right), president-elect of the Toledo Section, poses with fellow officers, C. C. Ackerman (left), second vice president; Frederick C. Miller (second from left), first vice president; and Eugene Kasper (right), secretary-treasurer.

Pleased by the results of the election of 1961 officers of the Central Illinois Section are (left to right) outgoing president, C. E. Kesler; J. D. Haltiwanger, new secretary-treasurer; William W. Froom, guest speaker at the December meeting; Gilbert D. Henning, second vice president; W. J. Roberts, first vice president; and H. O. Scheer, president.

John Fisk (second from left), Assistant to the Executive Secretary of ASCE, accepts the Oregon State College Student Chapter contribution of $25 to UEC Fund from Donald Russell, treasurer, at recent meeting. Prof. Martin Coopey (left), Faculty Adviser, and Thomas Edick (right), president, look on.

Members of the Alabama Section examine plans of the 309-ft high Lewis Smith rockfill dam during a field trip they made as part of their two-day annual meeting in December. Left to right are Manley A. Roose, general chairman of the program committee; Don H. Mattern, Vice President, Zone II; Harry E. Myers, president-elect of the Alabama Section; and Richard Woodruff, director of the section. Over 200 members and students from all parts of the state attended the session.

LOCAL SECTION MEETINGS

Central Ohio—Luncheon meeting at the Southern Hotel, Columbus, Ohio, on February 16, at 11:45 a.m.

Georgia—Dinner meeting at the Communicable Disease Center, Atlanta, on March 3, followed by tour of the Center.

Hawaii—Honolulu Post Convention Tour following the 1961 Phoenix Convention, April 20-21.

Los Angeles—Dinner meeting of the Sanitary Group at the Biltmore Hotel on February 22, at 6:30 p.m.; and social hour and dinner meeting of the Pipeline Group at the Engineers' Club in the Biltmore Hotel on February 28, at 6:30 p.m.

Metropolitan—Regular monthly meetings in the Engineering Societies Building on the third Wednesday of each month, at 7:00 p.m.; meeting of Associate Member Forum in E.S. Building, February 21, at 7:30 p.m.

Mid-South—Annual Spring meeting in Vicksburg, Miss., April 27-29. Host for the occasion is the Vicksburg Branch.

Philadelphia—Regular monthly meeting at the Engineers' Club on March 14, at 7:30 p.m.

Sacramento—Weekly luncheon meetings at the Elks Temple every Tuesday, at 12 noon.

Tennessee Valley—Annual spring meeting in Johnson City, Tenn., May 19-20.

Texas—Annual spring meeting in Waco, April 20-22.

NEWPORT NEWS HARNESSES 12,000,000 HORSES...

Since 1921 the total rated output of turbine contracts received by Newport News exceeds 12,000,000 horsepower. The Niagara Project, Grand Coulee, Hoover and Chief Joseph are but a few of the installations for which Newport News has designed and built such equipment as hydraulic turbines, valves, gates and penstocks.

Newport News has the men . . . the methods . . . and the machines to take gigantic jobs like these in stride. Large engineering and design staffs, hundreds of highly skilled workmen, five huge machine shops, a pattern shop and acres of foundries are perfectly integrated to produce large units in the shortest possible time . . . from water power equipment to wind tunnels, from cracking towers to paper dryer rolls.

Look to Newport News with its seventy-five years of metal fabricating experience. Your inquiries are invited.

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NEWPORT NEWS, VIRGINIA

BY-LINE WASHINGTON . . . . .

For civil engineers, probably the most significant pieces in Congress' opening-week flood of new bills (more than 2,000 the first day) were two of the numerous proposals for establishment of Departments of Urban Affairs and Transportation. The transportation idea was heavily bolstered, also by a mammoth report prepared by the staff of the Senate's Interstate Commerce Committee.

Neither of these departments, it now appears, will be approved this session—there are too many other areas in which the new Administration wants quick action, so it would prefer not to stand and fight here, if possible. And a fight is certain. Both departments would step on a lot of tender toes, upset a lot of long-standing relationships, and pose enormous new problems of their own.

However, lengthy discussion is inevitable. An example of what would be taken over—and of immediate problems of overlap just within the two new departments—is contained in the "findings and purpose" of Senator Keating's Urban Affairs bill (S 289), ". . . many important federal projects, such as housing, urban renewal . . . pollution control and highway construction have a primary impact on metropolitan areas . . ." And the bill goes on to provide that various functions of the Corps of Engineers, the Bureau of Public Roads, the U.S. Public Health Service, and other agencies may be transferred to the new department.

The "Department of Transportation", as outlined in the Senate committee staff report, would also take over functions of the Corps of Engineers and the Bureau of Reclamation, as well as of the Interstate Commerce Commission, the Federal Power Commission, the St. Lawrence Seaway Corporation, and the Panama Canal Company.

For the moment, anyway, nobody in Congress seems to be concerned over which new Department would take over which part of what, but it could become very complex. The new Administration seems to favor simply the appointment of a "coordinator" in the President's office (as suggested in the report to Mr. Kennedy by Dean James M. Landis). That would seem to make orderly provision for serious study and possibly Administration-backed legislation next year, and in the meantime fulfill campaign promises to get something started.

The report on transportation, mentioned above, has a curious background. The 900-page document was issued (after two years of study) not as a committee report, but as a "staff report" (thus the committee doesn't necessarily stand behind it). Only a very few copies were printed, and the only ones available to the press were "on display" and could not be removed from the premises. In addition to calling for elimination and consolidation of many agencies and functions, the highly controversial report calls for establishment of a two-headed organization—a cabinet department with policy-making and budgetary function, and a sort of super-commission to carry out regulatory functions. It also calls for tolls on the nation's waterways (waterways operators have already organized a special group to fight this) and a system of taxes to be paid into a trust fund modelled after the highway trust fund, from which costs of waterways improvements would be paid.

Out of the rest of the bills tossed into the Congressional hoppers in the first few weeks, there were none affecting engineers directly on a professional level, but there were many that—if enacted—would have much to do with conduct of business, and with future business prospects.

Not in any particular order as to importance, here is a quick early list: H.R. 10 (and S.197) to permit tax exemptions for the self-employed, through deductions for pension programs; H.R. 27, to provide a 10-year program of grants for construction of medical, dental, and public health educational facilities; H.R. 81 (and others) to provide reimbursement for states for free and toll roads taken into the Interstate System; H.R. 151, recognizing "state's rights" on control of water within state boundaries; H.R. 152, to expand the saline water conversion program (to a maximum of $20 million a year).

A very important measure is H.R. 166, which would give the President authority to disapprove "line items" (individual projects) in appropriations bills, without disapproving the entire bill; H.R. 243, providing financial assistance for construction of schools, teachers' salaries and the like; H.R. 269, providing for a study by the Commerce Department of the advisability of adopting the metric system; H.R. 776 and S. 174, to set up a system of "Wilderness Areas" in which no development of any kind would be permitted; H.R. 924, to permit fast amortization for income tax purposes of the cost of pollution treatment works; S. 239, to set up a "Resources and Conservation Council" to advise the President on development of water and other resources.

It is well to keep in mind that in the last Congress, something more than 18,000 bills were introduced. Of these, perhaps 2,000 became law.

* * *

Appointment of Rex M. Whitton, a civil engineer with more than 40 years of experience; of James K. Carr, a civil engineer; of John Moore, an educator; and re-appointment of Floyd Dominy, an agricultural and irrigation specialist; to top supervisory posts in the new administration, emphasizes again the importance of the so-called "second-echelon" posts in the Executive departments.

* * *

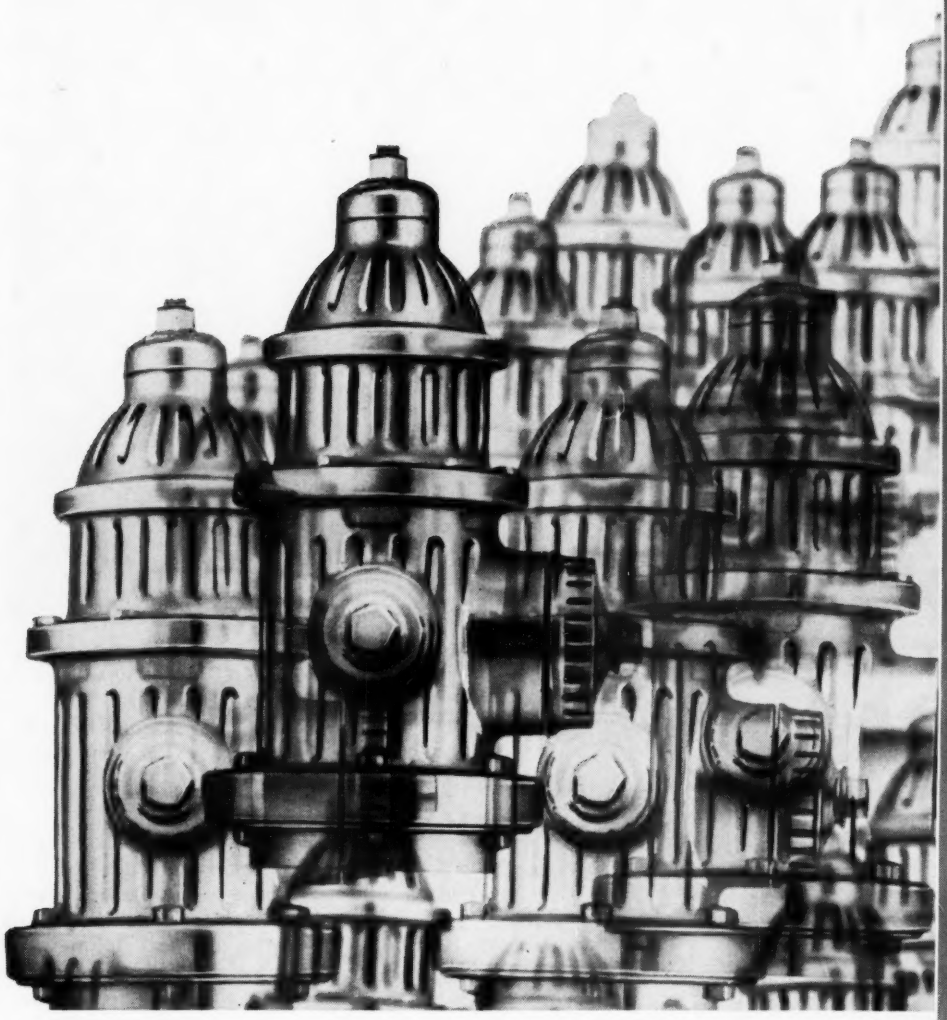
Apportionment of a total of $231.3 million in federal highway funds to the states finally brings total federal funds for fiscal 1962 to the approved $3.2 billion (including Interstate and so-called ABC roads). It will be recalled that the Bureau of Public Roads had to hold up apportionment of a third of the primary, secondary, and urban roads money, pending completion of population statistics drawn from the 1960 census.

* * *

Adding to the optimistic forecasts for the construction industry for the current year, the Associated General Contractors now sees a $57.3 billion year (with an added $19.5 billion for maintenance and repair work). This is directly in line with the forecast, a month ago, by the U.S. Department of Commerce. Added public spending, plus an upturn in private industrial work, are to be the spurs.

OVER A MILLION REASONS

WHY YOU SHOULD SPECIFY R. D. WOOD HYDRANTS AND VALVES



Reasons? Over a million hydrants now in service throughout the world. A number like that speaks for itself, says plenty about the outstanding features of the hydrant and the excellent service and reliability you can expect with R. D. Wood products.

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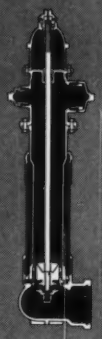
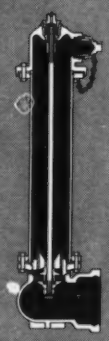
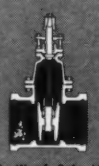


R. D. Wood Mathews Modernized Hydrant with replaceable barrel.

R. D. Wood Mathews Flange Barrel Hydrant . . . dry head construction keeps it operating in every kind of weather.



R. D. Wood Swivel Joint Hydrant can be faced in any direction.



R. D. Wood Gate Valve—bury it and forget it.

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These high-strength steels can contribute a saving of as much as 15% in the total construction cost of a concrete structure. The worker in the field can quickly find the right bar specified for the job; with the grade of steel well identified, many inspection and laboratory test charges may be eliminated.

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LACLEDE

LACLEDE STEEL COMPANY

SAINT LOUIS, MISSOURI ◆ Producers of Steel for Industry and Construction

Architect's sketch of new post office, Providence, Rhode Island. Architect-Engineer: Charles A. Maguire & Associates, Providence, Rhode Island.

First mechanized post office...

concrete domed shells provide 420′ x 300′ area with just two interior column groupings

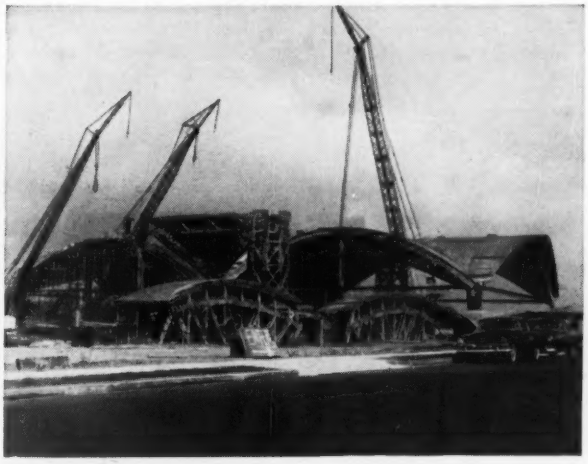
A mechanized post office at Providence, R. I., is first step in a postal modernization program that will eventually provide "next-day" delivery anywhere in the U.S.

Six intersecting concrete shells form the multiple domed roof. Two four-column groups provide the only interior support. This permits unobstructed floor space essential to the electronically controlled mail-flow layout and allows the flexibility required for experimental spotting and rearrangement of machines. Another benefit of a shell roof was to eliminate exterior buttresses of conventional arch construction which would interfere with outside truck traffic.

A concrete weighing 110 lb. per cu. ft. with a 2-inch slump and seven-day strength of 4,000 psi was used. Aggregate consisted of sand in combination with expanded shale. An air-entraining agent was added.

For design data on barrel shells and on standard, skewed, groined and sloping hyperbolic paraboloids, write for free literature. (U.S. and Canada only.)

PORTLAND CEMENT ASSOCIATION
Dept. A2-13, 33 W. Grand Avenue, Chicago 10, Ill.



FOR STRUCTURES... MODERN **concrete**

Falsework consisted of two identical sets of timber truss framing. 6″-thick shells each required 800 cu. yds. of concrete, placed in two operations. Spanning 150 x 140 ft., shells are separated by 2-in. expansion joints.

News Briefs . . .

Radar Tower Collapses in Atlantic

One of three Air Force radar towers located in the Atlantic as part of the nation's early warning system was destroyed by sea action January 15. This tower, 117 miles southwest of New York and 60 miles off Sandy Hook, N.J., was in 185 ft of water and had a platform 67 ft above sea level. The platform housed 28, none of whom survived.

The tower, the last of three constructed, was completed in 1958. The others, in 56 and 80 ft of water respectively, are standing satisfactorily. The structure cost $9 million and had radar and other equipment valued at $12 million. The tower had been damaged by Hurricane Donna in September, and repairs were being attempted at the time of the disaster. Most of the usual complement of 70 men had been removed. The Air Force had a standby crew of 14 aboard. The other 14 were employees of J. Rich Steers, Inc., marine contractors of New York, who were working on the repairs. (Steers, with Morrison-Knudsen, Inc., installed the tower originally.)

Rough seas made repair work extremely difficult, the tower was becoming increasingly shaky, and it was planned to evacuate it as soon as daylight made helicopter operation practical. Apparently conditions worsened suddenly, for a few minutes after a radio message indicating serious trouble was received the tower disappeared from radar screens.

Two of the three towers in the radar net were of the DeLong type, with a platform built as a barge and large pipe for support mounted through it. When this unit reached the desired location the pipe was lowered (spliced as required), and then the barge-platform was raised by jacks to the desired height.

For the tower off Sandy Hook three 12.5-ft-dia legs, each 314 ft long and 237 ft apart, were assembled and diagonally braced at a South Portland, Me., shipyard. There were three levels of bracing below water. With the empty legs to provide buoyancy the structure was floated out to position, with one leg high in the air, then upended and sunk at location by controlled flooding of the legs. The tower was founded in sand by jetting 15-ft-dia caissons at the end of each leg some 21 ft into sand. A platform, separately constructed on shore, was floated to position inside the legs and raised. Some concrete was placed in the legs for weight, but there was also space for storage.

Newspaper reports indicate that divers have sighted the platform at 50 ft below the water, with one leg broken off at 10 ft and another at 25 ft below the surface. Waves were said to have been 35 ft high, and gale force winds were at 50 to 70 knots at the time of failure. More severe storms had been weathered. In fact, a by-product of the tower operation has been useful data on wave heights in deep water.

Design of the three radar structures was handled for the Air Force by the U.S. Navy Bureau of Yards and Docks. Anderson-Nichols of Boston with Moran, Proctor, Mueser, and Rutledge of New York were architect-engineers.

1960 Steel Production Sixth Highest on Record

The steelmaking furnaces in the United States poured 99,277,760 net tons of ingots and steel for casting during 1960, the sixth highest annual output in history, according to a preliminary report of the American Iron and Steel Institute. The total was over 5.8 million tons above the 1959 production (affected by the steel strike) and only 15 percent below the 1955 peak of 117 million net tons.

The output of the second half of 1960 totaled 38,523,665 tons, compared with 60,754,095 tons made in the first half of the year. The fourth quarter's production was 18,876,320 tons, against 19,647,345 tons in the third quarter of the year. December output totaled 5,836,000 tons, compared with 6,171,940 tons made in November 1960.

Field Office Opened for Feather River Project

Opening of a Feather River Project field office at Palmdale, Calif., is one of the first results of the November elections in California, which gave the green light to the gigantic $1.75 billion project. The new office, opened by the State Department of Water Resources, will serve as headquarters for preconstruction exploration and location and right-of-way

New Face for the Nation's Capitol

Workmen put final touches to $11,000,000 Capitol rehabilitation project, which is being made ready for the inaugural ceremonies. The project provides the first major change in the appearance of the famous building since 1865, when the 4,500-ton, cast-iron dome was completed. The renovation has added 65 new rooms by moving the East front, or main facade, 32 ft forward from its original position. Shown are two special cranes with reach of over 100 ft, supplied by the Harnischfeger Corp., of Milwaukee, to handle the giant marble blocks and monolithic columns that had to be fitted into places where tolerances were often as little as 3/16 in. More than 100,000 ft of newly quarried marble was required for refacing. The Charles H. Tompkins Co., and Acme Stone Setters, Inc., both of Washington, were the contractor and subcontractor.

surveying along the southern reaches of the proposed aqueduct which will carry water from Northern to Southern California. The 28-man staff of geologists, surveyors, and right-of-way specialists is headed by John W. Marlette, senior engineering geologist.

Countless geologic and engineering details must be worked out before the final aqueduct alignment stakes are driven and excavation can start. Actual construction is scheduled to begin around 1964. It is expected that, by 1971, new water supplies will be serving thirsty communities all over Southern California from the state's delivery terminals at Castaic and Perris, and from turnoffs along the water line itself.

Correspondence Course Offered on Registration

For the first time a major university is offering correspondence courses to help engineers prepare for professional registration examinations. The course, entitled "Engineering Fundamentals," was developed for the University of California by Lloyd M. Polentz, professional engineer, author, and lecturer.

To prepare the course, Mr. Polentz analyzed more than 100 examinations used in 35 states. The new course is aimed at benefiting all engineers preparing for the first, or closed-book, portion of the engineering registration examination in any of the fifty states or three territories. Engineers wishing to review fundamentals as an aid to their work or in preparation for advanced study will also find the course helpful.

Further information and application forms for enrollment are available from the Department of Correspondence Instruction, University Extension, University of California, Berkeley 4, Calif.

Construction Starts On Solar Telescope

Astronomers are going underground to gain better views of the sun. This seeming paradox puzzles those who see construction in progress at the Kitt Peak National Observatory, Tucson, Ariz., where the world's largest solar telescope is taking shape. Unlike other telescopes, the distinguishing feature of the giant solar project is a 380-ft-long hole cored into the top of Kitt Peak, a mountain 40 miles southwest of Tucson on the Papago Indian reservation. The deep tunnel, 15 ft in diameter and blasted into the mountain at an angle of approximately 32 deg, looks more like a mine shaft than an astronomical research facility.

Rising nearby is a large pillar of steel and concrete, upon which will rest a motor-driven flat mirror called a heliostat. Standing 110 ft above the ground, the heliostat will track the sun and reflect an image of it down an angled shaft extending from the top of the pillar to the bottom of the mountain tunnel—a total distance of almost 500 ft. From that point the solar image will be reflected 280 ft to a third mirror which will project it into an underground observing room. There the image—as large as 34 in. in diameter—may be photographed or directed to spectroscopes for study by scientists.

The big instrument will form images of the sun several times larger and more brilliantly illuminated than are obtainable with any other solar telescope. When it is completed in 1962, it will be available to all qualified scientists for research purposes.

The instrument is being built for the National Science Foundation by the Association of Universities for Research in Astronomy, Inc., operator of the observatory. The NSF has earmarked $4,000,000 for the Kitt Peak solar program.

Booklet Discusses High-Strength Bolting

A current issue of *Fasteners*, available gratis to qualified engineers, tells the complete story on high-strength bolting. The 40-page booklet (1) covers bolting practice in field and shop; (2) gives complete specifications for structural joints using ASTM A325 bolts; (3) has the first report on the new heavy structural bolt and data on interference (ribbed) body bolts; and (4) details identification marking of bolts and nuts. The mechanics of the turn-of-nut method is presented. Experts outline the advantages of high-strength bolting.

The booklet will be useful in the design office, fabrication shop, and field office. More than 50 manufactures of bolts, nuts, and other fastenings produced this reference through their trade organizations. Write to Industrial Fasteners Institute, 1517 Terminal Tower, Cleveland 13, Ohio.

Throgs Neck Bridge Is Opened to Traffic

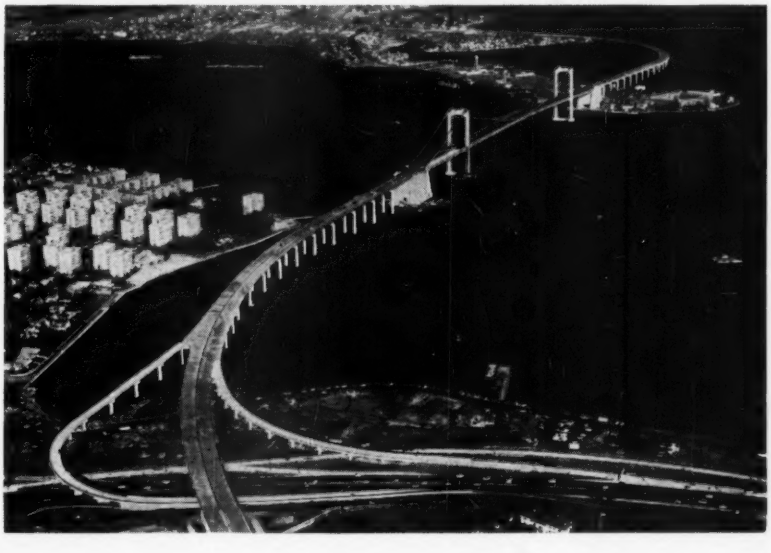
A new traffic link between New York and Long Island was forged on January 11, with opening of the $92,000,000 Throgs Neck Bridge connecting the eastern Bronx with Bayside, Queens. Despite cold weather, about 1,500 were on hand to watch Mayor Wagner cut a ribbon stretched across one of the lanes. Opened at the same time were the Clearview Expressway in Queens and the Throgs Neck and Cross-Bronx Expressway in the Bronx. They will speed traffic to existing highways at either end of the bridge.

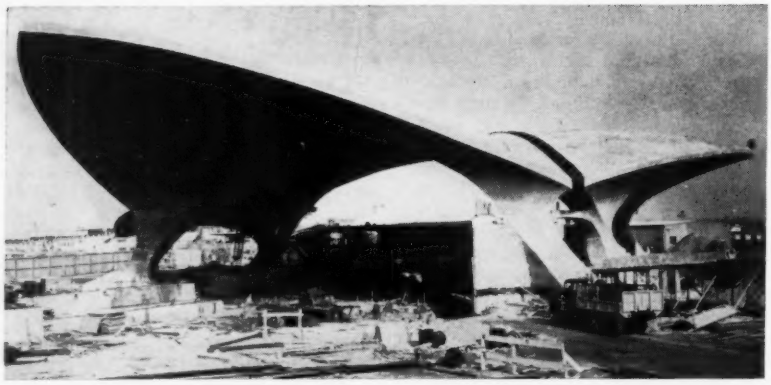
The new bridge, including approaches, has a total length of 12,000 ft and will carry six lanes of traffic. The suspended portion has a center span of 1,800 ft with side spans of 555 ft. Approach spans vary from 50 to 191 ft.

The suspended span was erected by the American Bridge Division of the U.S. Steel Corp. The Bethlehem Steel Co. erected the 326-ft steel towers and set most of the approach spans on the Queens side of the bridge. Harris Structural Steel erected the Bronx approach.

The new bridge is a project of the Triborough Bridge and Tunnel Authority. Ammann & Whitney designed the main span, and E. Lionel Pavlo the approaches.

This aerial view of the Throgs Neck Bridge was taken just prior to its formal opening on January 11. The facility, owned and operated by the Triborough Bridge and Tunnel Authority, will speed the flow of traffic between the Bronx and Long Island. Photo courtesy of Bethlehem Steel.





TWA Terminal Under Construction at Idlewild

Sweeping, bird-in-flight effect characterizes Trans World Airlines' dramatic new terminal building at New York International (Idlewild) Airport. There was no appreciable settlement of the 11,100,000-lb roof as the 5,500 lengths of tubular steel support were removed and the 1¼-acre roof, in four shells, settled on four slender but very sturdy buttresses. The building will be enclosed with temporary material so interior work can continue through the winter. Completion is planned for late 1961. Architect Eero Saarinen is the designer, with Ammann and Whitney doing the structural engineering.

ASCE Members Figure In New Administration

James K. Carr

In appointing James K. Carr, F. ASCE, of Sacramento, Calif., as Under Secretary of the Interior, Secretary Stewart Udall has named a civil engineer to probably the highest rank held by any member of the profession in the new Administration. As Under Secretary, Mr. Carr is actually second man in the department, outranking department heads such as the Commissioner of Reclamation and agency heads such as the Administrator of Highways.

A civil engineering graduate of Santa Clara College, Mr. Carr joined the Bureau of Reclamation's engineering staff in 1934. He remained with it (finally becoming manager of the Chico district in Northern California) until 1951. In the latter year he joined the staff, as engineering consultant to the House Interior and Insular Affairs Committee, remaining in that post until 1953, when he took his present position as assistant general manager of the Sacramento Municipal Utility District. In addition he was recently appointed chairman of the California Water Commission.

James K. Carr

Rex Whitton

Rex Whitton

President Kennedy has named Rex Whitton, F. ASCE, chief engineer of the Missouri Highway Department, Jefferson City, Mo., Federal Highway Administrator to succeed Bertram D. Tallamy. Mr. Whitton, who has been with the Missouri Highway Department since 1920, is nationally known for his pioneer road work in Missouri. Recent honors accorded him include the George S. Bartlett Award, in 1958, which cited him as "the nation's outstanding road builder." Last year he was selected by the American Public Works Association and Kiwanis International as one of the "top ten public works men of the year."

More Spending for Electric Power Plants

A 1961 construction budget of more than $116 million—more than half of it slated for electric power plant construction—has been announced by the American Electric Power Company. The company's 1960 construction budget was $100 million. According to Philip Sporn, F. ASCE, president of the company, this year's outlay will bring to more than $1.5 billion, the capital expenditures of AEP's six operating utilities since the end of World War II.

Close to $35 million has been allocated for extension or improvement of the American Electric Power system's transmission and distribution lines. The bulk of power plant construction in 1961 will be carried on by the Appalachian Power Company which is expected to spend close to $62 million. Included in this is work on Appalachian's 440,000-kw, two-dam hydro project at Smith Mountain on the Roanoke River in Virgnia and the new 225,000-kw generating unit at its Clinch River Plant at Carbo, Va.

More Natural Gas for Southern California

A proposal to bring into southern California vast new supplies of natural gas to be used in generating electricity has been presented to the California Public Utilities Commission by the Southern California Edison Company and the California Gas Transmission Company, a subsidiary of the Tennessee Gas Transmission Company. Some of the gas, to be piped from Texas and northern Mexico, would also be made available to local gas companies during periods of peak use.

The proposed gas pipeline would be about 1,600 miles long, running south from the Texas Gulf Coast fields to Reynosa, Mexico, then northwest to the Los Angeles area. The estimated cost is $225,000,000. Construction and operation of the line will be handled by the Tennessee Gas Transmission Company through its subsidiaries. Target date for first deliveries of gas over the new line is July 1, 1962.

Deep-Sea Drilling To Start in March

Plans for an experimental deep-sea drilling program, beginning in March, to test equipment and techniques for possible use in Project Mohole have been announced by the National Science Foundation. The ultimate goal of Project Mohole is to drill through the earth's crust under the ocean to determine the composition and physical properties of the crust and of the underlying rock known as "the mantle." A test site for the experimental drilling has been chosen near Guadalupe Island, off the western coast of Mexico, in 12,000 ft (about 2.3 miles) of water.

A $735,750 contract for the test drilling has been awarded the Global Marine Exploration Co., of Los Angeles, Calif., by the National Science Foundation. The program is under the technical direction and scientific guidance of the AMSOC Committee of the National Academy of Sciences-National Research Council.

Dr. Alan T. Waterman, director of the National Science Foundation, called the experimental drilling "an initial attempt to drill into the ocean floor in very deep water, and the first practical test of deep-sea drilling engineering capabilities evolved through several years of intensive study and planning."

Nearly all previous offshore drilling has been in water less than 100 ft deep,

with the drilling platform standing on the ocean bottom. Anchored vessels have worked in water 400 ft deep and drilled as far as 10,000 ft. In the current tests, drilling will be attempted with an unmoored 260-ft drilling ship holding its position by means of four large outboard motors, in water roughly 30 times deeper than the 400-foot depth.

The actual Mohole must be drilled at sea through the thinner suboceanic crust because the crust under continents is too thick to be penetrated. Beneath the continents, the earth's crust is from 15 to 20 miles thick, being thickest under mountains, while the suboceanic crust may be as thin as 2.5 miles in some places. The eventual Mohole may be drilled in water as much as 18,000 feet deep (3.4 miles) into a thickness of about 15,000 feet of crustal rock, a total of about 32,000 feet (6 miles). The deepest hole ever drilled from land is just over 25,000 feet (4.7 miles) in depth. Drilling will be done by the standard rotary method used on land by the petroleum industry.

Ohio River Electric Station in Operation

Early in January one of the nation's largest steam-electric generating units was placed on operation on the Ohio River at Graham Station, W. Va. The 500,000-kw unit is located at the Philip Sporn Plant, owned jointly by the Ohio Power Company and the Appalachian Power Company, operating subsidiaries of the American Electric Power Company.

Like its sister unit, in operation since July at the AEP System's Breed Plant on the Wabash River in Indiana, the new facility is capable of filling the electric requirements of more than a million average American homes. It boosts the capacity of the Sporn Plant to 1,100,000 kw, making it the fifth largest steam-electric generating plant in the U.S.

The new unit employs the world's largest—and the country's second—water-cooled generator in a pioneer move to increase operating efficiency. The turbine-generator unit, designed and built by General Electric, receives 3,000,000 lb of steam an hour from a 23-story boiler. The boiler was made by the Babcock & Wilcox Company. Spent gases from the furnace exhaust through a concrete stack 550 ft tall.

New Headquarters Office for NCSBEE

The National Council of State Boards of Engineering Examiners has moved its headquarters from Columbia, S.C., to Clemson, S.C., where it has offices in the new Civil Engineering Building of the Clemson College School of Engineering. The building was completed in 1958 to provide expanded civil engineering teaching facilities.

James H. Sams has taken over the duties of executive secretary of the NCSBEE from T. Keith Legare, F. ASCE, who retired recently after 37 years of service to the Council.

Construction Volume Declines in 1960

For the calendar year 1960, the value of new construction put in place totaled $55 billion, according to the Bureau of the Census of the U.S. Department of Commerce. This was just 2 percent below the record total of $56.2 billion reported for 1959. Expenditures for private construction, at $39 billion, were also 2 percent below 1959, while public construction, at $16.1 billion, was only 1 percent less than the $16.3 billion reported for the previous year.

A significant aspect of the year-to-year change was the decrease of $2.4 billion in private residential building. This amount was only partially compensated for by the increase of $1.1 billion in private nonresidential building.

The $4.4 billion spent for new construction in December 1960 represented a seasonal 9 percent drop from November, but was only 1 percent below December 1959 outlays. The December estimates include $3.1 billion for private construction (7 percent less than the November 1960 figure) and $1.2 billion for new public construction (a greater than seasonal decline from November expenditures of $1.4 billion). Private outlays were 9 percent below the December 1959 level, whereas public construction was 4 percent above the figure for the same month.

The Bureau of the Census notes that in making comparisons with data for 1959 it should be kept in mind that estimates for 1959 (beginning with September) reflect the effects of steel shortages resulting from the strike.

Designer Chosen for Missile Test Stands

Design and engineering work on two major missile test facilities will be performed by Aetron, a division of Aerojet-General Corporation, Azusa, Calif. One contract is for a Saturn static test facility at the George C. Marshall Space Flight Center at Huntsville, Ala.; the other, for the Rover nuclear rocket-engine test cell, to be constructed at the Atomic Energy Commission's Nevada test site.

The Saturn project will be used for static tests of space boosters in the Saturn class. The Rover test cell will provide a "down firing" test stand to be fabricated largely from aluminum alloys because of radiation problems. Construction cost of the two facilities will be over $17,000,000.

Precast, Prestressed Beam for New York Pier

When a precast, pretensioned beam for the concrete superstructure of new Pier 40 in New York was found to be too long, a new seven-ton, 41-ft-long beam was ordered, fabricated, steam-cured, shipped 10 miles to the site, and erected on the job —all in a record 24 hours. A costly delay in the erection was thus avoided through the cooperation of the Department of Marine and Aviation of the City of New York and close coordination among Roberts and Schaefer Company, the Engineers; the Corbetta Construction Company, the contractors; and Precrete, Inc., the subcontractors.

Contract for New Lock At Sault Ste. Marie

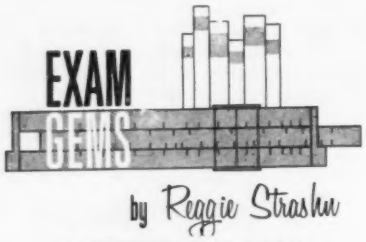
Award of a $4,947,950 contract for first-stage construction work on the new second lock at Sault Ste. Marie, Michigan, to A. S. Wikstrom, Inc., of Skaneateles, N.Y., is announced by the Detroit District of the Corps of Engineers.

Work on the contract, scheduled to get under way this spring, calls for the construction of cofferdams to keep the water out, demolition and removal of the existing lock, excavation for the new lock, reconstruction of the east and west center piers, construction of an overlook platform and construction of an access bridge.

Award of the contract signals the start of a four-year construction project being undertaken by the Corps of Engineers for a new $33,000,000 navigation lock which will replace the 64-year-old Poe Lock, oldest of the U.S. locks.

The new lock will be the widest and deepest of the locks—one Canadian and four American—at the Soo. It will be 1,000 ft long, 100 ft wide and have 32 ft of water over the sills. The Davis and Sabin locks, built from 1908 to 1914 and from 1913 to 1919, are 1,300 ft in length, the longest in the world. They are 80 ft wide, with 32 ft of water over their sills. The fourth in size—the MacArthur Lock, completed in 1943 at a cost of $14,000,000—is 800 ft long, 80 ft wide, and has 31 ft of water over the sills.

The importance of the locks at Sault Ste. Marie is demonstrated by the fact that, in 1953, a record of 128 million short tons of freight for all locks was established. As many as 600 different vessels of varying sizes pass through these locks in a year.



R. ROBINSON ROWE, F. ASCE

EXAMGEN No. 19 asked for diagrams of hydrostatic pressure on a bridge pontoon loaded eccentrically. As weight (W) and load (L) were easily computed and pressure diagram could be just as easily deduced from draft and heel of the pontoon, discussion will be limited to the latter.

Reference is made to Examgem No. 14, for which heel was given and an eccentric moment arm was sought. The reverse problem is not quite as easy because it leads to a cubic equation, but the analysis can be simplified if variables and moment center are carefully chosen and we use units which avoid large numbers.

For the latter, it will be convenient to express all forces in terms of unit displacement, letting $p = Aw = (60)(300)(62.424) = 1{,}123{,}600$ lb per ft of draft. Then the pontoon weight of 7,021,600 lb becomes $6.25p$, and the eccentric load of 900,000 lb becomes $0.8p$.

These are supported by buoyant uplift equivalent in magnitude and centering to the weight of water displaced, considered either as a trapezoidal area ABED or its aliquot parts. The trapezoid may be divided in several ways, but we will choose the rectangle ABCD with altitude a, representing a force of ap, and the triangle CDE with altitude $2h$ (twice the heel), representing a force of hp. Summing vertical forces,

$$ap + hp = 6.25p + 0.8p$$
$$h + a = 7.05 \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Our other equation must be derived from a summation of moments of the four forces. Because the heel complicates the moment arms with a large probability of mistake in computing them and no graphical check available, it will be safer to measure along the right lines of the pontoon for arms which can be used with components of the forces normal thereto.

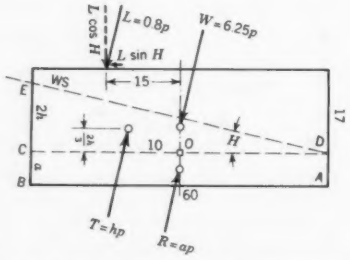


Fig. 1. As shown for L, forces are resolved before taking moments about O.

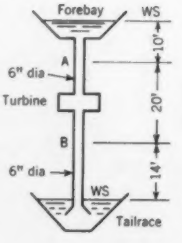


Fig. 2. Diagram for Examgem No. 20.

Accordingly, we choose O for the moment center at midpoint of CD on both the central axis of the pontoon and the boundary of rectangle and triangle. Axial components of forces $6.25p$ and ap are collinear with this origin and have no moment. Balancing the other six and showing arms in parentheses for the reader to check:

$$\sin H\,[6.25p(8.5 - a) + 0.8p\,(17 - a) + ap(\tfrac{1}{2}a) - hp(\tfrac{2}{3}h)] + \cos H\,[0.8p(15) - hp(10)] = 0$$

Now if we divide thru by p, the equation is geometric. Dividing also by cos H, we can eliminate the heel angle by substituting tan $H = h/30$. Then multiplying thru by 360 to clear of fractions, we have

$$75h(8.5 - a) + 9.6h(17 - a) + 6ha^2 - 8h^3 - 3{,}600h + 4{,}320 = 0 \quad \ldots\ldots\ldots (2)$$

from which a is eliminated by the substitution $a = 7.05 - h$ to derive

$$h^3 + 1{,}549h = 2{,}160 \quad \ldots\ldots\ldots\ldots (3)$$

$h = 1.393$ and $a = 5.657$

It should be noted that the cubic Eq. (3) is trivial, with $h^3 = 2.7$, so that a fair answer is given by $h = 2{,}160/1{,}549$. When the heel is small, a quick and close approximation is given by the column formula, or by using the metacenter as we did for Examgem No. 14, but error is intolerable for large heels. Better practice using an "exact" method.

A somewhat quicker "exact" method uses a rectangle with altitude $a + h$ and two triangles with altitude h and base half the beam, one being negative and the two forming a couple. However, negative areas seem to confuse many during the mental stress of examinations, so don't use it unless you've had lots of practice.

Choice of this problem as an examgem was influenced by a demand for "more on buoyancy." Because of its age (November 1939), its effectiveness is not known to Reggie.

EXAMGEM No. 20

In the diagram of a power plant (Fig. 2), find pressures at A and B and the power transmitted to the turbine by a flow of 3 cfs. Neglect entrance and friction losses in pipe and turbine and assume full recovery of velocity head at the tailrace.

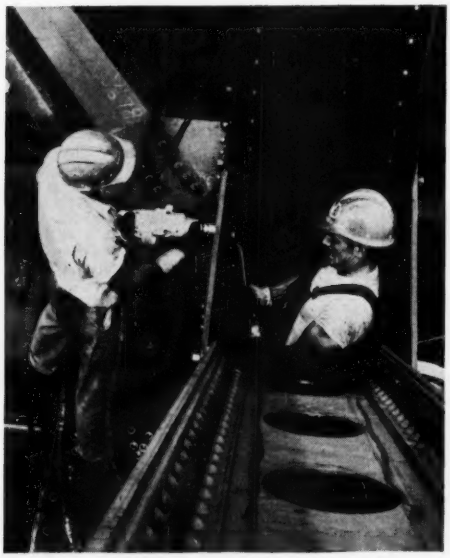
Financing for Large Montreal Development

Completion of financing for its $80,000,000 Place Ville-Marie development, now under construction in downtown Montreal, is announced by Webb & Knapp (Canada), Ltd. Under the investment plan, Webb & Knapp and United Kingdom interests will each own half the stock of a new holding company, Trizac Corporation, Ltd., which will own the development.

Scheduled for completion in 1962, the Place Ville-Marie development is dominated by a 42-story cruciform skyscraper, sheathed in anodized aluminum and glass. It is being built on a seven-acre site over Canadian National Railways tracks in the business center of the city. In addition to the skyscraper, the project includes a three-acre plaza and office building above a multi-level underground parking garage and a large shopping center. Promenades will link the shopping center to nearby hotels, offices, and the railroad station. The project will have about 2,300,000 sq ft of rentable office space.

Owners: Chicago, Burlington and Quincy Railroad Co. Consulting engineers: Howard, Needles, Tammen and Bergendoff

Longest railroad bridge to be high-strength bolted



The entire 4½-mile-long, CB&Q Railroad crossing, bridging the Mississippi near Quincy, Illinois, was designed for field riveting. But unusually high flooding and difficulty in locating experienced riveting crews caused delays in completing the 336-ft through-truss span, shown above. To speed up the job, Bethlehem requested the approval of the CB&Q to bolt the remaining two-thirds of the crossing, requiring 140,000 high-strength bolts.

The switch to high-strength bolts allowed trains to use the new bridge weeks earlier than riveting would have permitted.

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High-strength bolts are ideal for both railroad and highway bridges. They speed erection. And they hold firmly in place after years of constant vibration, a fact which has been proven in a series of field tests held under the supervision of the Association of American Railroads.

FREE BOOKLET—Information on Bethlehem high-strength bolts, complete with latest specifications and a section on how to order high-strength bolts, is available in our booklet, "High-Strength Bolting for Structural Joints." For your copy call the Bethlehem office nearest you, or write to us at Bethlehem, Pa.

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New Publications

Concrete standards . . . . Publication of a "Manual of Standard Practice for Reinforced Concrete Construction" is announced by the Western Reinforcing Steel Fabricators Association, an organization that serves the fabricating industry in nine Far Western states. In addition to proposed fabricating and placing standards, the manual outlines the range of services performed by the fabricator, and suggests how special services should be requested in the interest of obtaining the most favorable bid. Copies, at $5.00 each, may be ordered from the Western Reinforcing Steel Fabricators Association, 1322 Webster Street, Oakland 12, Calif.

Highway contracts . . . . A comprehensive analysis of highway contracting procedures has been completed by a special committee of the Highway Research Board. The findings—based on a survey of the statutes of all the states—have been published by the Board as Special Report 51, entitled "Highway Contracts." The report sells for $4.00, and is available from the Highway Research Board, 2101 Constitution Avenue, N.W., Washington 25, D.C.

Recharging water wells . . . . How research paid off in a practical solution to the water supply problems of an Illinois City is told in a report just published by the State Water Survey, scientific research division of the Illinois Department of Registration and Education. Through nine years of research, Survey scientists developed a successful pit method of artificial recharge for the heavily used underground water supplies at Peoria. The report, identified as Bulletin 48, was written by Dr. Max Suter, F. ASCE, former head of the Survey, and his successor, Robert H. Harmeson, M. ASCE. For free copies write the State Water Survey, Box 232, Urbana, Ill.

Steel standards . . . . Release of two new standard steel specifications is announced by the American Institute of Steel Construction. "Specification and Loading Tables for Open Web Steel Joists" (long-span or L-series) has also been adopted by the Steel Joist Institute and supersedes an earlier AISC-SJI specification, which has appeared in the AISC Manual of Steel Construction since 1955. "Specifications for Architecturally Exposed Structural Steel" is a completely new standard. Free copies of the two specifications are available from the AISC, 101 Park Avenue, New York 17, N.Y.

Highway research . . . . A wide range of road research is covered in recent publications of the Highway Research Board. Bulletin 254, entitled "Soil Compaction and Proof-Rolling of Subgrades," sells for $1.00; Bulletin 256, "Urban Research, 1960," 80 cents; and Bulletin 258, "Electronic Surveying, 1960 Developments," 80 cents. The December 1960 issue of "Highway Research Abstracts" is devoted to synopses of papers for the 40th annual meeting, held in Washington, D.C. January 9-12, 1961. Inquiries should be addressed to the Highway Research Board, 2101 Constitution Avenue, N.W., Washington, D.C.

Scientific activities, Federal agencies . . . . Announcement of the eighth report in a series describing policies and practices of Federal agencies in scientific and technical information activities is made by the National Science Foundation. The current report—entitled "Scientific Information Activities of Federal Agencies" and identified as NSF 60-59—is sold by the U.S. Government Printing Office (Washington 25, D.C.) at 10 cents a copy.

Building research . . . . The proceedings of two research correlation conferences conducted as part of the 1960 spring conferences of the Building Research Institute's Division of Engineering and Industrial Research are now available. They deal with insulated masonry cavity walls (Publication 793) and paints and coatings (Publication 796) and sell for $4.00 and $5.00, respectively. Orders should be sent to the Building Research Institute, Division of Engineering and Industrial Research, 2101 Constitution Avenue, N.W., Washington 25, D.C.

Surveying instruments . . . . Latest edition of its annual 192-page, combination astronomical and surveying instrument manual is announced by the Keuffel & Esser Co., Hoboken, N.J. Copiously illustrated with diagrams, charts, and schematic drawings, the "1960 Solar Ephemeris and Surveying Instrument Manual" is pocket-sized for convenience.

Timber decking . . . . Issuance of a new Standard for Heavy Timber Decking (Section 1200) is announced by the American Institute of Timber Construction. The 28-page standard, under development for two years, covers species, sizes, patterns, length, moisture content, application, specifications, applicable allowable unit stresses and roof load span tables. Single copies are available without charge from the American Institute of Timber Construction, 1757 K Street, Washington 6, D.C.

Marine waste disposal . . . . California's marine waste disposal research program—conducted since 1953 by the State Water Pollution Control Board—has been summarized by the Board in order to enable regional pollution control boards to prescribe waste discharge requirements and to establish monitoring programs for the receiving waters. Identified as Publication No. 22, the summary may be purchased from the State Printing Division, Documents Section, Sacramento 14, Calif., at $1.00 a copy. The four-cent sales tax must be added by residents of California.

City planning . . . . Publication of the new (1960) edition of "Planning the Neighborhood" is announced by the Public Administration Service. The new reference comprises Vol. 1 of the three-volume series, *Standards of Healthful Housing*, by the Committee on the Hygiene of Housing of the American Public Health Association. The 108-page publication sells for $3.00 and is available from the Public Administration Service, 1313 East 60th Street, Chicago 37, Ill. The other volumes in the series, which are also available, are "Planning the Home for Occupancy" ($2.00), and "Construction and Equipment of the Home" ($2.00).

Industrial waste disposal . . . . The valuable papers presented at the Seventh Ontario Industrial Waste Conference—held at Honey Harbour, Ontario, in June 1960—have been made available in a 168-page mimeographed publication. Of special interest are papers on recent developments in the handling of radio-active wastes and oxidation ponds for industrial waste treatment. Inquiries should be addressed to the sponsoring organization, the Water and Pollution Advisory Committee of the Ontario Water Resources Commission, East Block, Parliament Buildings, Toronto, Ontario.

Bituminous materials . . . . Both highway engineers and builders working with roofing materials will be interested in the 1960 edition of the "Compilation of ASTM Standards on Bituminous Materials for Highway Construction, Waterproofing and Roofing." The 474-page volume, consisting of over 100 specifications, methods of tests, and definitions, will serve as a guide for the production and all-around use of bituminous materials. It includes over 40 new or revised standards. Copies may be obtained from the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., at $5.50.

Air pollution . . . . Availability of "Cleaning and Purification of Air in Buildings," the proceedings of a program conducted as part of the 1960 Spring Conferences of the Building Research Institute's Division of Engineering and Industrial Research, is announced by the BRI. Identified as Publication 797, the 63-page report may be purchased from the Building Research Institute, 2101 Constitution Avenue, N.W., Washington 25, D.C., at $4.00 a copy.

Water supply . . . . Although daily rainfall in the U.S. averages 4,300 billion gallons, less than one-third of it reaches the nation's rivers and only about 7 percent, or about 314 bgd, is considered dependable on a long-term basis. Evaporation and water losses from vegetation consume more than two-thirds of the rainfall before man gets a chance at it. These are some of many fascinating facts in "Availability and Use of Water in the United States," a new special report published by the Water Information

(Continued on page 104)

One of the two 380-ton MURCO Gate Hoists furnished to the Power Authority of the State of New York.

Each hoist operates a gate 46′ wide by 67′ high at one foot per minute. These gates divert the water from the Niagara River above the Falls into covered conduits five miles long. The two conduits bring the water to the Niagara Generating Plant on the United States side of the Falls.

The engineers on this project are Uhl, Hall Rich of Boston, Massachusetts.

MURCO Gate Hoists are designed and made for any size power dam . . . capacities from less than 1 ton to over 375 tons . . . from the smallest hand operated to the largest motor operated gate hoist, all made to specifications.

Write for complete information . . . Engineering Department recommendations . . . when you are planning power dam projects.

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THIN SHELL CONCRETE ROOF PROVIDES UNOBSTRUCTED FLOOR AREA

Lehigh Early Strength Cement Saved Construction Time

• Six intersecting concrete shells form the multi-domed roof of this newly completed, already famous automated post office. Although it's nearly as large as three football fields (300′ x 420′) the entire structure has only *two* interior columns . . . a design which provided tremendous flexibility for the arrangement and experimental modification of complex mechanical equipment.

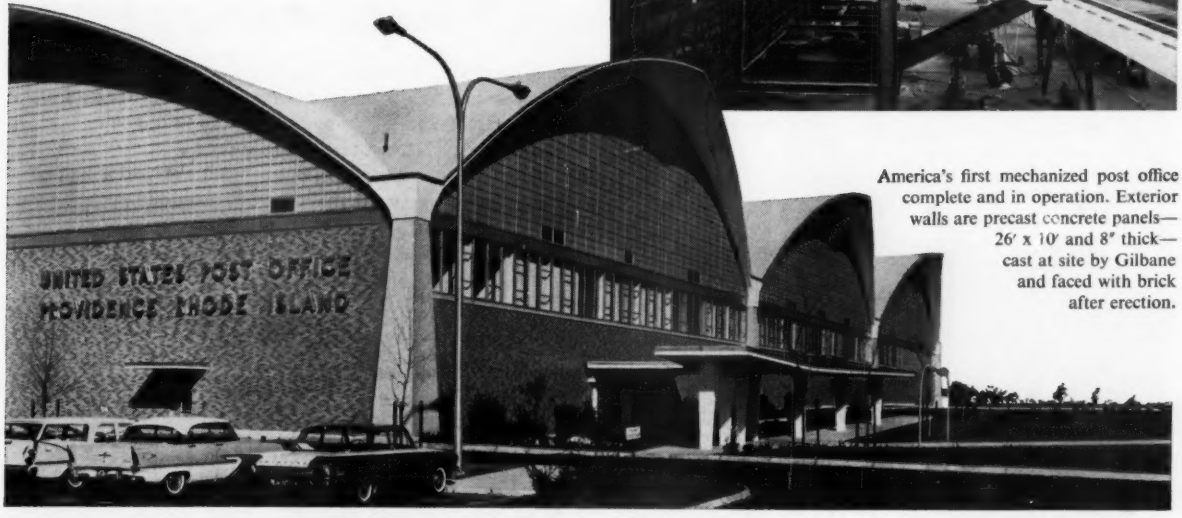
Construction of the roof, with its parabolic slopes and rises, was a challenging operation. But careful planning and precise scheduling by Gilbane Building Company was seen in the progress of the work, much of which had to be done during short Rhode Island winter days.

Contributing to the fast concreting schedule was Lehigh Early Strength Cement, which made it possible to start stripping forms in just 7 days. This is about ¼ the time that would have been required with normal cement . . . and is typical of the advantages of Lehigh Early Strength Cement in modern concrete construction. Lehigh Portland Cement Company, Allentown, Penna.

Placing lightweight—110 lbs. per cu. ft.—concrete was an exacting operation. Two pours, one of 540 cu. yds. and one of 260 cu. yds., were required for each 140′ x 150′ shell unit. Shells are only 6″ thick.

Complex mechanical equipment needing unobstructed floor area can be seen in this view. Height from floor to peak of each dome is 55′.

LEHIGH CEMENTS



America's first mechanized post office complete and in operation. Exterior walls are precast concrete panels—26′ x 10′ and 8″ thick—cast at site by Gilbane and faced with brick after erection.

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• *Architect-Engineer:* Charles A. Maguire & Associates, Providence, R. I. • *Contractor:* Gilbane Building Co., Providence, R. I. and New York, N. Y.
• *Lightweight Concrete:* Pawtucket Redi-Mix Concrete Co., Pawtucket, R. I. • *Regular Concrete:* Morse Sand & Gravel Co., Attleboro, Mass.

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DECEASED

Ivan Crawford, Former Director of ASCE, Dies

Ivan Crawford (M. '25; F. '59), age 74, nationally known engineering educator, who served between the years 1923 and 1951 as dean of the engineering colleges at the Universities of Idaho, Kansas and Michigan, died recently at Boulder, Colo. His activities included service with the Peace Commission (World War I) to Belgium as chief of its building section; responsibility for the World War II Navy V-12 program; and adviser to the Defense Department in 1949 concerning the curricula at West Point and Annapolis. In recent years, Mr. Crawford had served as director of the Colorado Water Conservation Board (1953-1958), as a member of the Colorado House of Representatives (1958-1960), and at the time of death was completing a six-year term on the Board of Visitors of the U.S. Military Academy. Mr. Crawford was Director of ASCE from 1935 to 1937 and chairman of the Society's Education Committee for two years.

William H. Armstrong (M. '49; F. '59), age 58, designer of Techwood homes, the first public housing project in the United States, died on December 22 in Atlanta, Ga. In the years since 1932, when he organized Armstrong Structural Engineers (now Armstrong and Edwards Structural and Consulting Engineers), he and his firm have designed major buildings at the Charleston Navy Yard and the U.S. Marine base at Parris Island, as well as numerous public, industrial and commercial buildings in the South.

Philip Bruton (M. '40; F. '59), age 68, Brigadier General, U.S. Army (retired), died in Great Falls, Mont., on November 7. General Bruton was formerly Pacific division engineer with the Army Corps of Engineers. He resided in Millbrae, Calif.

V. K. Crocker (A.M. '50; M. '59). age 55, since 1949 an assistant civil engineer of the New York City Board of Water Supply, died in New York on December 29. Mr. Crocker, a native Russian, arrived in this country in 1927, and entered the Army Corps of Engineers as a design engineer. Following World War II he was associated with the civil engineering firms of Andrews & Clark and Parsons, Brinckerhoff, Quade & Douglas.

Earl Devendorf (M. '57; F. '59) age 73, who devoted 40 years to the promotion of better health for the people of New York State, died in Schenectady, N.Y., on December 28. He retired two years ago as director of the State Health Department's Bureau of Environmental Sanitation, after ten years of service to the department.

James J. Doland (M. '27; F. '59); age 70, professor emeritus of hydraulic engineering at the University of Illinois, died in Urbana, Ill., on December 23. His retirement two years ago ended a 32-year career in the civil engineering department that included, in addition to his teaching duties, such special service as the development of the University of Illinois Airport, for which he was designer and supervisor of construction. A writer of note, he was co-author of several books and handbooks in the water supply field. From 1933 to 1935, Professor Doland served on the executive committee which set up the program and regulations under which the Division of University Exten-

(Continued on page 98)

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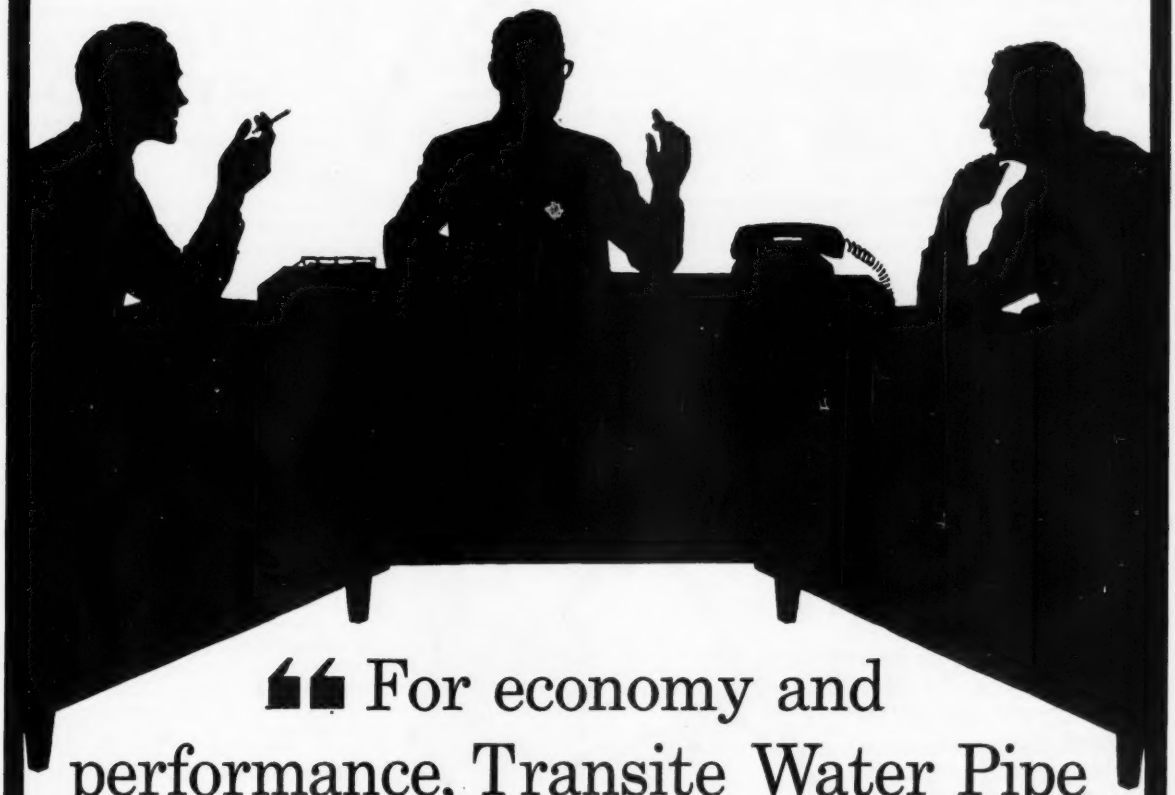
Three County Commissioners from Ohio report:



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"When we began designing another expansion of the system for 1960, our previous experience made Transite the main choice. The Belmont Water System now has 53 miles of Transite installed in rocky terrain and corrosive soils. The excellent performance of the first 13-mile section leads us to believe that Transite will provide economical maintenance and operation for many years."

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Deceased

(Continued from page 96)

sion functions. Dr. Doland had also served as consultant to many government agencies, including the Bureau of Reclamation and the National Resources Planning Board.

Clarence E. Ellsworth (A.M. '13; M. '59), age 78, who retired in 1953 as Texas district engineer for the U.S. Geological Survey, died in Austin, Texas, on December 4. In a 43-year career with the Survey Mr. Ellsworth furnished basic water information to planners and operators of all important water development projects constructed in Texas, and special equipment he developed is still in use. In 1952, he received the Distinguished Service Award of the Department of the Interior "in recognition of his many achievements and contributions, both technical and administrative."

Le Roy Engstrom (M. '56; F. '59), age 54, named chief of the River Control Branch of the Tennessee Valley Authority in 1958, died in Knoxville, Tenn., on December 23. His career with the TVA began in 1935 when, as a junior hydraulic engineer, he joined the Engineering Planning and Geology Division at Knoxville. He progressively moved up the ladder, becoming head of the River and Reservoir Forecasting Section in 1952 and assistant chief of the River Control Branch in 1957. Early in his career he was in the Water Resources Branch of the U.S. Geological Survey.

Earl J. Felt (M. '48; F.'59), age 52, manager of the transportation development section of the Portland Cement Association's Research and Development Laboratories, died recently in Skokie, Ill. Mr. Felt's engineering career included four years with the Minnesota Highway Department, three years with the U.S. Forest Service, and 20 years with the Portland Cement Association. He was well known for his laboratory studies and his many published papers dealing with highway engineering.

George C. Habicht (A.M. '19; M. '59), age 75, since 1930 president of the Cable Guide Railing Construction Company at Depew, N.Y., died recently. Mr. Habicht's career with the construction company dated back to 1924 when he joined the firm as engineer and general manager, becoming vice president one year later, and president five years after.

Clarence E. Harness (A.M. '50; M. '59), age 47, appointed deputy manager of public works for Denver, Colo., last March, died in that city recently. Concomitant with the post of deputy manager, Mr. Harness was city engineer, having previously served as assistant sanitary engineer in the city engineer's office. Mr. Harness was in the U.S. Army from 1940 to 1947, retiring with the rank of lieutenant colonel.

Gage Haselton (M. '43; F. '59), age 79, retired division engineer for the Southern Pacific Railroad, died recently in Suncook, N.H. Subsequent to joining the railroad as assistant engineer in 1904, Mr. Haselton was named assistant division engineer in 1909, and division engineer in 1943. He held the position of division engineer at the time of his retirement thirteen years ago.

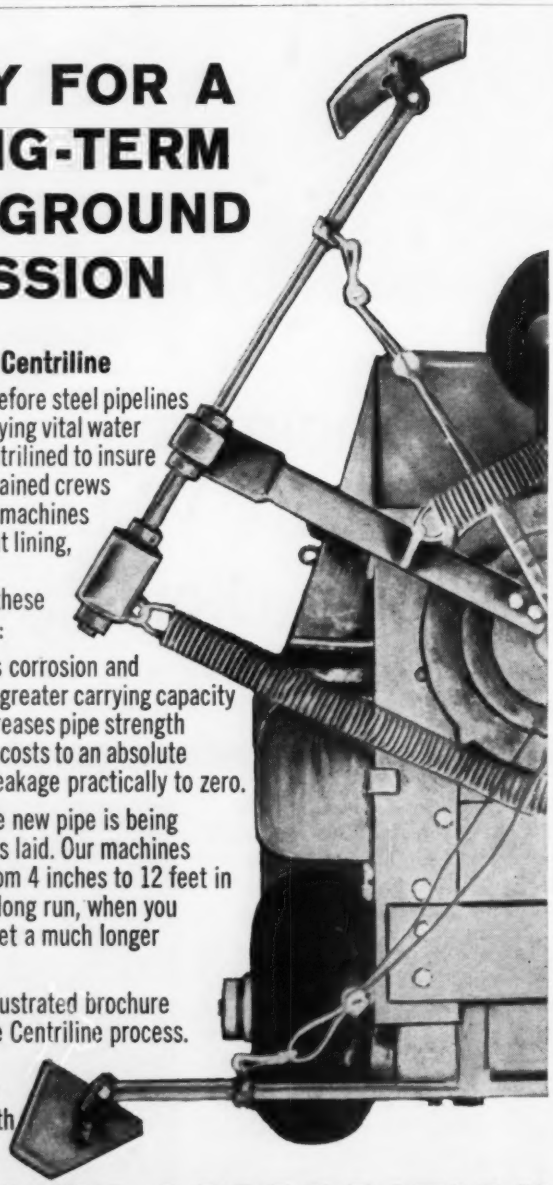
Robert Hayden (A.M. '36; M. '59), age 73, from 1939 until his retirement in 1953, a construction engineer who served as purchasing agent for the Turner Construction Company, died recently in Philadelphia, Pa. In the 1940's Mr. Hayden constructed naval air bases on the Pacific Islands of Honolulu, Midway, Wake, Samoa, Guam and Manila. Earlier, he was Turner's agent on the Tasker Housing Project built for the Philadelphia Housing Authority.

C. S. Herrick (M. '25; F. '59), age 82, a retired civil engineer for the city of Syracuse, N.Y., died there recently. Mr. Herrick, who went to Syracuse around the turn of the century, retired from municipal employment in 1942. He was a graduate of Syracuse University.

Martin R. Huberty (M. '59; F. '59), age 66, professor of irrigation and engineering at the University of California, Los Angeles campus, and director of the

(Continued on page 100)

READY FOR A LONG-TERM UNDERGROUND MISSION



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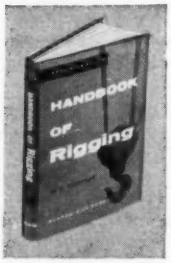

Handbook of Rigging by W. Rossnagel. 2nd Ed. A complete guide showing how to handle every step in any rigging operation.
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Foundations of Structures by C. Dunham. Provides sound help on every important phase of foundation engineering.
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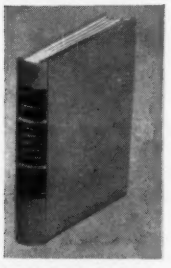
Publisher's Price, $17.50 Club Price, $14.95

Estimating Construction Costs by R. L. Peurifoy. 2nd Ed. Techniques and data to help you make accurate estimates.
Publisher's Price, $11.50 Club Price, $9.80



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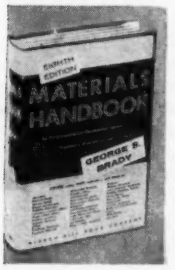

Soil Mechanics, Foundations, and Earth Structures by G. T. Tschebotarioff. Gives principles and practices.
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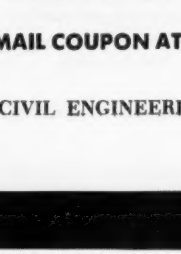

Materials Handbook by G. Brady. 8th Ed. Provides helpful facts on properties, uses, sources for thousands of natural and synthetic materials.
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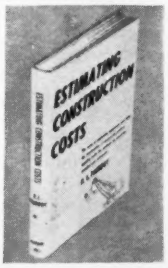

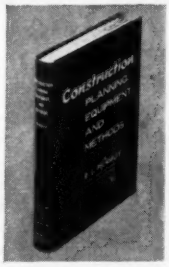

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CNG-2

Deceased

(Continued from page 98)

Water Resources Center there, died in Los Angeles on December 12. On the University of California staff from 1921 until his death, he did pioneer work on soil compaction. Professor Huberty was also acting dean of the College of Agriculture. On leave from the university in the early 1950's, Dean Huberty served as senior irrigation and drainage officer for the Food and Agriculture Organization of the United Nations in Rome.

John Sexton James (M. '48; F. '59), age 75, retired civil engineer of Ontario, Calif., died in that city recently. For 14 years he was Montana State Engineer, and had also served as water consultant to the Pakistani government.

Carl H. Knoettge (A.M. '17; M. '59), age 75, retired structural engineer, of Boulder, Colo., died there recently. At the time of his retirement six years ago, Mr. Knoettge had had a varied career as an instructor in the colleges of engineering at Cornell University and at his alma mater, the University of Colorado; as hydraulic and structural draftsman with the Denver Municipal Water Works; and as structural engineer with Earl C. Morris, Denver architect.

Oliver C. Lockhart (M. '28; F. '59), age 71, for many years district bridge engineer for the Utah district of the U.S. Bureau of Public Roads, died recently in Ogden, Utah. During 36 years of service with the Bureau, he was responsible for the design of many structures in Zion National Park, in many west coast parks, and on forest road highways. He retired from the Bureau of Public Roads in 1957 and, in 1958, became a consultant to the Bridge Department of the Utah Department of Highways.

Charles MacDonald (M. '18; F. '59), age 75, who as Westchester County's (New York) first fulltime superintendent of highways from 1916 to 1930, laid out the county parkway system, died in North Tarrytown, N.Y., on December 10. Since then he has served as consultant on the development of New York's Idlewild Airport and on the construction of the Major Deegan Expressway in the Bronx and the New York Thruway.

Robert L. MacDougall (A.M. '36; M. '59), age 59, for many years one of Georgia's leading civil engineers, died in Atlanta on December 6. President of the MacDougall-Warren Construction Company, Inc., a road paving firm, he was one of the "prime movers" in the drive to start a modern expressway system for Atlanta, serving as chairman of the Metropolitan Bond Commission in 1946. At the time of his death he was chairman of the Fulton County Industrial Authority to develop the industrial potential of the county. He had served in Washington as assistant national commissioner and chief engineer of the Works Progress Administration, resigning in 1942 to join in founding the construction firm of MacDougall-Warren.

Ross L'Estrange Mahon (M. '36; F. '59), age 70, retired Pacific Coast representative of the S. Morgan Smith Company, died recently in Carmel, Calif. Before joining the company in 1946, Mr. Mahon had served for seven years as sales engineer with the Soule Steel Company and for twelve years with the Pelton Water Wheel Company, four of them as general manager and vice president.

Frank J. Musso (M. '48; F. '59), age 62, for the past 40 years on the staff of the New York City Board of Water Supply, died in Liberty, N. J., on November 5. Mr. Musso had served the Board as division engineer since 1947 when he directed construction of Neversink Dam and its appurtenant works.

Robert Franklin Olds (M. '24; F. '59), age 79, at the time of his retirement in 1951 chief of the division of operations of the Corps of Engineers at Portland, Ore., died recently in Arlington, Va. From 1928 to 1931, he was resident engineer for the New England Power Association on a $20 million hydroelectric project on the Connecticut River known as the Commerford Dam. More recently Mr. Olds was construction engineer for the Tennessee Valley Authority on the $33 million Pickwick Dam on the Tennessee River and principal engineer of the flood control division of the Federal Power Commission in Washington, D.C.

Francis H. Phipps (M. '48; F. '59), age 66, a senior engineer in the New York City Department of Public Works, died on January 16 in Mount Vernon, N.Y. Mr. Phipps had been with the department for 35 years and was assistant to the chief of the construction section in the Division of Buildings. A colonel of the Army Chemical Warfare Service during World War II, he won a citation for gallantry.

Thomas Francis Quinn (A.M. '17; M. '59), age 77, since 1926 assistant engineer for the Kansas City Southern Railway Company, died recently in Shreveport, La. Until his retirement in 1954 Mr. Quinn handled all engineering for the Southern Division of the railway.

Charles H. Schwertner (A.M. '25; M. '59), age 65, a founder of C. H. Schwertner and Son, Inc., general contractors in Philadelphia, Pa., died in Daytona Beach, Fla., on December 18. Mr. Schwertner had been residing in Daytona Beach since his retirement ten years ago.

George P. Seeley (A.M. '20; M. '59), age 74, former president of the Frederick Snare Corporation of New York City, international engineering and construction concern, died recently in Englewood, N.J. At his death he was assistant to the

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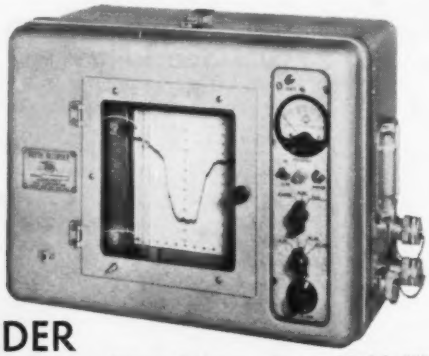

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chairman of the board of directors. Earlier he had served the Snare Corporation as manager of the firm's several offices, as a vice president and director and, from 1948 to 1958, as president. Mr. Seeley was instrumental in the construction of various ports throughout Latin America and aided in the design and building of the Triborough Bridge, the Bronx Whitestone Bridge, and the Chesapeake Bay Bridge.

William D. Shillinger (M. '57; F. '59), age 42, assistant director of the Division of Sanitary Engineering, Indiana State Board of Health, died recently in Indianapolis, Ind. After joining the staff of the State Board of Health in 1940, Mr. Shillinger served it as director of the branch office at La Porte, resigning in 1959 to become assistant director of the sanitary engineering division. He helped organize the Indiana Section's Northwestern Branch and was president in 1957.

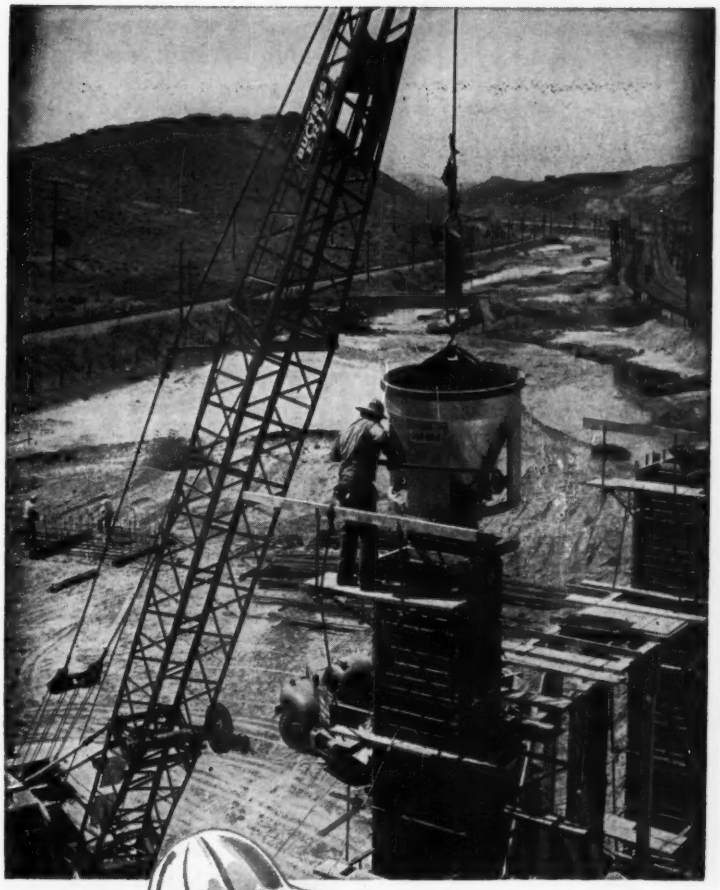
Clifford Vaughn Smith (A.M. '57; M. '59), aged 57, resident engineer director of the District of Columbia Department of Highways and Traffic Bridge Division, died recently in Washington. He had served as resident engineer on the Twelfth Street Expressway and the Anacostia Freeway. Earlier he was chief construction engineer for 35 years with Alexander and Repass, General Contractors.

Vernon N. Taggett (M. '43; F. '59), age 73, since 1952 chief engineer for the Berrien County (Michigan) Road Commission and former Niles city engineer, died in that city recently. In his early career he was in railroad work and in hydrographic work for the Army Corps of Engineers. He was city engineer of Niles from 1921 to 1950.

Hubert S. Tullock (M. '17; F. '59), age 76, for nearly 40 years president of Missouri Valley Construction, Inc., died recently in West Falmouth, Mass. In the early stages of his career Mr. Tullock had served with the Missouri Valley Bridge and Iron Company as assistant secretary and treasurer and as manager of its highway bridge department.

Eric H. Wang (M. '55; F. '59), age 54, Kirkland (N. Mex.) Air Force Base official, died in Albuquerque on December 4. Dr. Wang was scientific adviser for the research directorate and chief of the directorate's structure division at the base.

Albert M. Zabriskie (A.M. '07; M. '59), age 75, former chief engineer of the Central Railroad of New Jersey, died on January 2 in North Plainfield, N.J. He had been associated with the railroad for 44 years when he retired in 1948.



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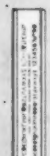

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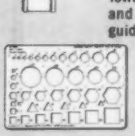

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American Congress on Surveying and Mapping and American Society of Photogrammetry. Convention at the Shoreham Hotel, Washington, D. C., March 5-10.

American Institute of Chemical Engineers. National meeting at the Roosevelt Hotel, New Orleans, La., February 26-March 1.

American Railway Engineering Association. Annual meeting at the Conrad Hilton Hotel, Chicago, Ill., March 7-9.

American Road Builders' Association. Fifty-ninth annual convention at the Chalfonte-Haddon Hall, Atlantic City, N. J., March 5-8.

American Welding Society. Forty-second annual convention and welding exposition at the Commodore Hotel and the Coliseum, New York, N. Y., April 10-21.

Associated General Contractors of America. Annual meeting at the Statler-Hilton Hotel, Boston, Mass., February 27-March 2.

Conference on the Mechanics of Soil-Vehicle Systems. First international conference at the Turin Institute of Technology, Turin, Italy, June 1961.

Instrument Society of America. Annual symposium on "Temperature, Its Measurement and Control in Science and Industry," co-sponsored by the American Institute of Physics and the National Bureau of Standards in Columbus, Ohio, March 27-31.

Traffic Institute, Northwestern University. Eighth annual traffic engineering seminar at the Institute, Evanston, Ill., March 6-24.

University of Michigan. Fourth conference on Great Lakes research, sponsored by the Great Lakes Research Division (formerly Great Lakes Research Institute) of the University's Institute of Science and Technology in the Rackham Building, Ann Arbor, Mich., April 17 and 18.

New Publications

(Continued from page 94)

Center, Inc., 60 East 42nd Street, New York 17, N.Y. The eight-page analysis is available at $2.00 a copy, postpaid.

Professional Engineer review . . . . Engineers preparing for the Professional Engineer examinations will find "Engineering Review" by Prof. Harold W. Knutsen, M. ASCE, of the University of Wisconsin, helpful. The review, consisting of lecture notes and problems with solutions, is available from the Burgess Publishing Company, 426 South Sixth Street, Minneapolis 15, Minn. It is $4.00.

Construction, nineteenth century . . . . The development of building techniques in the past century with emphasis on new materials and their effect on structural practices is the theme of "American Building Art—the Nineteenth Century" by Carl W. Condit. Wood framing, iron framing, wooden bridge and iron bridge trusses, the suspension bridge, the iron arch bridge, and concrete construction are among the subjects considered in detail. Copies are $12.50, and the publisher is the Oxford University Press, 417 Fifth Avenue, New York, N.Y.

Soil studies . . . . The scope of "Soil Investigation for Building Foundations" is to outline methods and procedures by which subsurface conditions may be analyzed as a basis for designing suitable foundations. The report—prepared by Prof. R. E. Means, F. ASCE, of Oklahoma State University, as Publication No. 84—is organized under three broad headings: (1) Preliminary investigations, (2) special or detailed investigations, and (3) choosing a suitable foundation. Copies, at $3 each, may be ordered from the Office of Engineering Research, Oklahoma State University, Stillwater, Okla.

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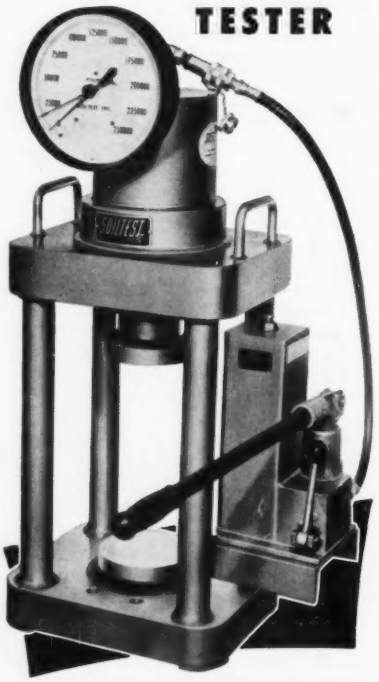

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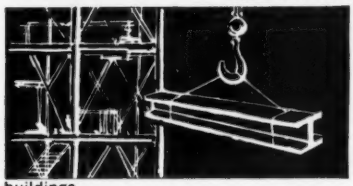

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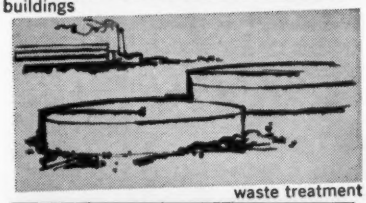

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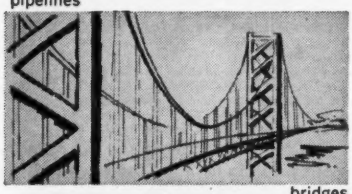

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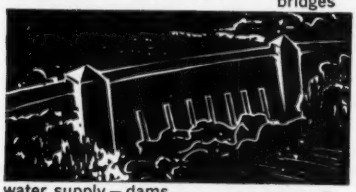

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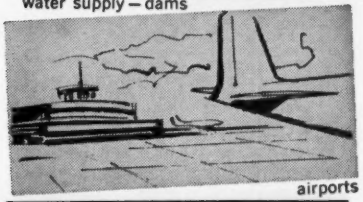

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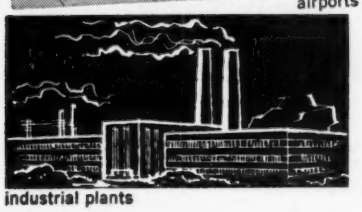

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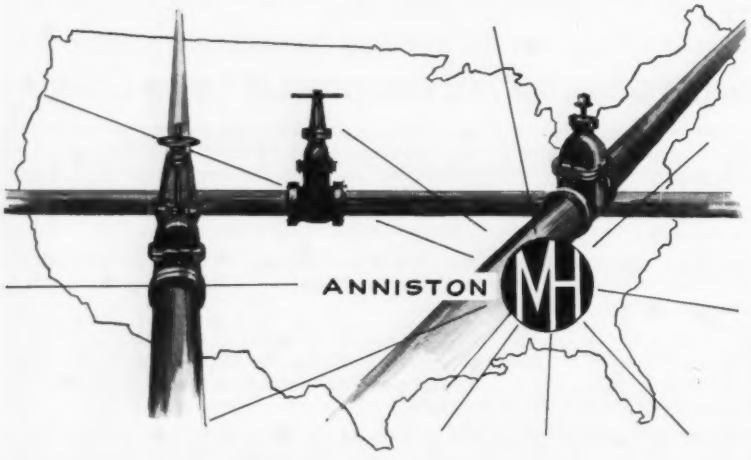
[Applications for the grade of Associate Membership from ASCE Student Chapter Members are not listed.]



a better Mouse Trap

The original use of iron body, bronze mounted valves in America came about through the discovery of steam power and the resulting industrial expansion about 1850 and later. In fact, the valves of those times were called "steam specialties."

Then in 1920, one of the old line valve companies was liquidated and much of the equipment for manufacturing iron body, bronze mounted valves and fittings was sold to a group of men in Anniston, Alabama.

That was the beginning of M & H! The first M & H valves were made in 1926, but difficulties were encountered and by 1932 annual sales volume was only $95,000. During that year of business depression, the Company was reorganized, refinanced, its products redesigned, its foundry and plant subsequently mechanized – and M & H started to grow!

It is the old story of "build a better mouse trap and the world beats a path to your door" – except in this case it was a better valve and hydrant. Today, 28 years later, M & H dollar volume of sales amounts to many millions annually.

Such growth in sales volume is no accident. Hard-boiled engineers and utility management buy valves where they get most for their dollars.

(No. 9 of a Series)

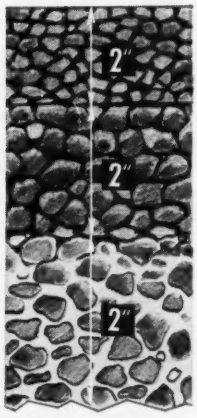
M&H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA
SUBSIDIARY OF WALWORTH

FOUND!

A winning combination: Asphaltic concrete made with Chevron Asphalt over a Dilute Bitumuls Treated Base.

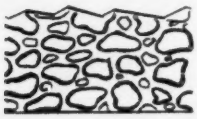
For "Deep-Strength" Construction PLUS Economy!

Realignment of U. S. Route #99 (Pacific Highway) between Albany and Eugene, Oregon, involves construction of twelve miles of new, heavy-duty pavement.



4 inches Asphaltic Concrete made with Chevron Asphalt; laid in 2 lifts as indicated.

Top 2 inches of crushed stone base treated with diluted Bitumuls; then compacted.



Compacted base stone

The original "specs" called for construction of a compacted stone base, surfaced with 4 inches of asphaltic concrete. As a result of preliminary tests, however, a Field Change Order was issued specifying treatment of the top 2 inches of the base with an economical nine-to-one dilution of Bitumuls.

Dilute Bitumuls Treatment "controlled" the top of the base during surfacing; provided water-resistance that contributed to an overall stronger pavement. Over the base, two lifts of asphaltic concrete made with Chevron Asphalt were placed to complete the construction.

The job is under the direction of the Oregon State Highway Department. The contractor, Warren Northwest, Inc., has done a fine job of coordinating all phases of the job. One key factor in maintaining operations on schedule has been the dependable, on-time service on Bitumuls and Chevron Asphalt deliveries.

Call office nearest for details on how Bitumuls Emulsified Asphalts and Chevron Paving Asphalts can be combined to give you better pavements at lower cost.

Dilute Bitumuls-Treated Base

Surfacing (made with Chevron Asphalt)

American Bitumuls & Asphalt Company

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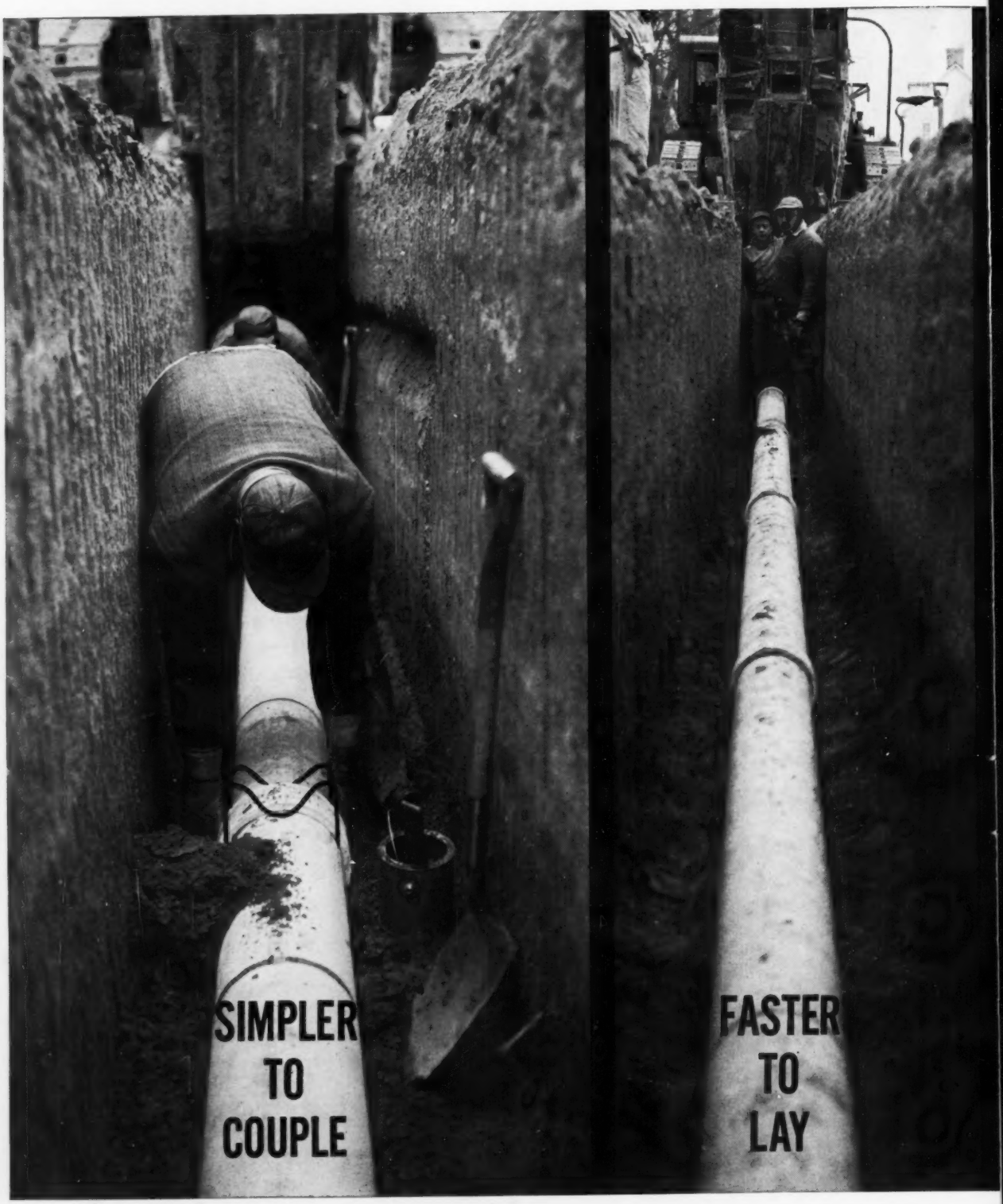
"YOU'RE MONEY AHEAD WITH K·M BEST IN ASBESTOS



ASBESTOS-CEMENT SEWER PIPE!"

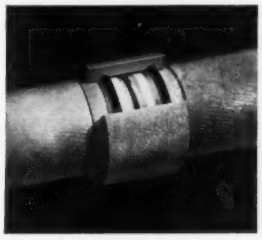
says prominent New Jersey contractor

. . . after laying more than 6 miles of "K&M" asbestos-cement sewer pipe

With the completion of the new sewer installation in New Jersey's thriving town of Marlton, Clyde Fear of Gray & Fear, contractors, had lots to say about "K&M" Asbestos-Cement Sewer Pipe. Here's what he told us. "You're money ahead with "K&M" Asbestos-Cement Sewer Pipe. Our men like the simple "K&M" couplings that slide in fast without any heavy machinery, and, believe us, that's one place where we save time and money. These simple coupling joints go miles faster. The pipe is easy to handle; there's less breakage on the job or in the storage yard. No lost time because of bad weather, either, because we can lay and couple this pipe in muddy trenches."

What Marlton, New Jersey, gained with "K&M" Asbestos-Cement Sewer Pipe, you can gain for your community, too. The pipe's smooth bore remains clean. This permits flatter grades . . . means fewer lift stations and lower pumping costs. It all adds up to less tax money for sewer installation and maintenance for your community.

Write today for more information on "K&M" Asbestos-Cement Sewer Pipe. Write to: *Keasbey & Mattison Company, Ambler, Pa., Dept. P-1521.*



FLUID-TITE COUPLING—an exclusive feature of "K&M" Asbestos-Cement Sewer Pipe. You simply lubricate the rings and slide in the pipe without heavy tools. The coupling is permanently tight, eliminates infiltration, and keeps out roots.

"K&M" Asbestos-Cement Sewer Pipe installation, Marlton, N. J.; Engineers: Sherman, Taylor & Sleeper, Merchantville, N. J.; Contractor: Gray & Fear, Woodbury, New Jersey.

Keasbey & Mattison at Ambler

Pipe plants at Ambler, Pa.—St. Louis, Mo.—Santa Clara, Cal.

ASBESTOS-CEMENT SEWER & PRESSURE PIPE

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If you are interested in any of these listings, and are not registered, you may apply by letter or resume and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular placement fee. Upon receipt of your application a copy of our placement fee agreement, which you agree to sign and return immediately, will be mailed to you by our office. In sending applications be sure to list the key and job number.

When making application for a position include eight cents in stamps for forwarding application.

Men Available

STRUCTURAL OR CIVIL ENGINEER, F. ASCE, B.S.C.E. (Structural); P.E. and Surveyor—Ohio, 45. Six years' field engineering, locks, dams, flood control projects and industrial facilities for metals industry; two years' liaison engineering aircraft industry; 13 years' design chemical and metals industry buildings and facilities. Salary, $10,500. Prefer, S.E. Ohio or Ohio valley. C-642.

PROFESSIONAL CIVIL ENGINEER, M. ASCE, A.B. and M.S. in C.E. Ten years' top experience with consultants in highways, structures, traffic and airports. Significant achievements in supervision, planning, development, coordination, design, and engineering reports. Desire new position with challenge and opportunity. Minimum salary, $10,000. C-643.

PROJECT MANAGER-CONSTRUCTION SUPERINTENDENT, M. ASCE, civil graduate. Thirty years' in full charge and responsibility in the field for National Companies on construction of steam and hydro power, chemical and industrial plants, R.R. terminal, concrete and earth fill dams, research laboratories, atomic pile, air bases. C-644.

PROFESSOR OF CIVIL ENGINEERING, F. ASCE, M.C.E., 38. Six years of recent teaching experience, including mechanics, structural and concrete design courses, and graduate courses in theory and design, and 12 years of diversified industrial experience in design and research. Desires permanent teaching position at a university. C-645.

CIVIL ENGINEER, M. ASCE, P.E., 49; competent mathematics, languages, music. Technical experience (mostly structural)—process industries, steam power, institutional buildings, highways. Would serve where creative thought and objective approach are needed. C-646.

CIVIL ENGINEER, A.M. ASCE, B.S. Civil. Experienced as a field engineer with the Bureau of Public Roads; as a highway designer with the Interstate Highway, and as office engineer and designer for developer of massive subdivisions. Salary, $8,500. Prefer, Northeastern U.S. C-647.

SOILS, MATERIALS OR CONSTRUCTION ENGINEER, A.M. ASCE, B.S. and M.S. Civil Engineering. Four years' experience in heavy earth construction, soils and materials lab., and surface water research and applications. Pilot license. Prefer heavy construction or soil and materials field work. Salary, Domestic $6,900. Prefer, West or Foreign. C-648.

SOILS ENGINEER, A.M. ASCE, B.S.C.E. One year as soils engineer, interested in professional development. Experience in laboratory soil testing, studies of strength properties of frozen soils and reference report on frost penetration. Completed 2 years in U.S.C. & G.S. Prefer, East. C-649.

HIGHWAY ENGINEER, F. ASCE, B.S.C.E., P.E.; Highway and bridge engineer on highest type projects for 35 years. With one organization 30 years. For the past 15 years in responsible supervisory capacities successively as bridge engineer, supervising highway engineer, and district engineer. Salary, $12,000 (Would deviate for preferred location). Prefer, East, South preferred. C-650.

CONCRETE SPECIALIST, A.M. ASCE, B.S.C.E., M.S.C.E., P.E., interested in production and development and supervision of precast concrete or technical and applied research in concrete development, Industry or University. Eighteen months' fellowship associated with technical university in Europe studying applied techniques and problems in use and manufacture of precast concrete. Superintendent and manager of construction projects. Fluent knowledge of languages. C-651.

MANAGER OR CHIEF ENGINEER, M. ASCE, B.S.C.E., Reg. P.E., 34. Ten years' experience in design and fabrication of metals, including light gage as well as structural steel and concrete. Present duties require knowledge of shop practice as well as technical assistance to sales department in customer contact. Salary, $12,000. Prefer, U.S.A. C-2063-Chicago.

ADMINISTRATIVE ENGINEER, F. ASCE, Illinois licenses. Twenty-five years' experience, structural engineer, land surveyor, professional engineering experience moveable and fixed bridges, highway, port development and drainage toll roads. Prefer administration, investigational, specification or report editing. Salary, $9,000. Prefer, Chicago. C-2064-Chicago.

SANITARY OR CIVIL ENGINEER, A.M. ASCE, B.S.C.E., P.E., 33. Eight years' experience in design, layout, specifications and estimates for roads, layouts, water supply, sewage disposal and military facilities. Desires responsible and challenging position. Available immediately. Salary, $10,000. Prefer, Midwest or Southwest. C-2065-Chicago.

CIVIL ENGINEER, A.M. ASCE, M.S.C.E., 28. Four years' intensive experience as chief engineer with a consulting firm. Proficient in C.E., M.E., I.E. and plant engineering. Salary, $7,200. C-2066-Chicago.

SALES, PRODUCT AND MARKET DEVELOPMENT, A.M. ASCE, B.S.C.E., M.B.A. 33. Sales and sales management. Develop products and marketing programs. Five years' experience with machinery manufacturer. Four years as estimator, project engineer with contractor. Prefer, Milwaukee, C-2067-Chicago.

BRIDGE ENGINEER POSITIONS

THE BUREAU OF PUBLIC ROADS has need for two bridge engineers in the career Civil Service, a specialist in welding and a specialist in foundations. C.E. degree, professional registration, or equivalent experience.

WELDING SPECIALIST: Requires professional experience in application of theory and practice of welding to bridge engineering. Duties include research, study, and analysis of problems relating to structural design and welding.

FOUNDATIONS SPECIALIST: Requires professional experience providing detailed knowledge of bridge engineering theory and practice, and understanding of scientific principles of geology and soil mechanics. Duties include investigation and analysis of foundation design.

SALARY: $10,635 per year.

LOCATION: Washington, D.C.

TRANSPORTATION: Paid.

Mail resumé to:

U.S. BUREAU OF PUBLIC ROADS
PERSONNEL AND TRAINING DIVISION
1717 H STREET NW.
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BRIDGE DESIGNER

Creative, interesting work in progressive organization offering career opportunities under Civil Service. Civil Engineers with experience in structural drafting or design.

Beginning Salary $480-600 per month depending on previous experience and training.

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OREGON STATE
HIGHWAY DEPARTMENT
SALEM, OREGON

ADMINISTRATIVE ENGINEER, A.M. ASCE, B.A. Public Administration, B.S.C.E., 33. Experience includes five years of structural designing experience in reinforced concrete, steel and timber; one year of administrative duties in personnel, particularly concerned with records and procedures. Salary, $7,800. Prefer, Midwest. C-2068-Chicago.

STRUCTURAL ENGINEER OR RESEARCH ENGINEER, A.M. ASCE, M.S.C.E., 26. Experience includes one year in designing and detailing of structures; three and a half years in research in structural engineering. C-2069-Chicago.

CIVIL ENGINEER, A.M. ASCE, B.S.C.E., E.I.T. Certificate, 24. Prior to college worked during summers as laborer, equipment operator and foreman for construction company and two summers in highway design. Two years' in sales, design and production of precast reinforced and prestressed concrete products. Prefer, Midwest or West. C-2070-Chicago.

CIVIL AND STRUCTURAL ENGINEER, M. ASCE, B.S.C.E., Registered in Michigan, 39. Twelve and a half years' varied experience in design of industrial buildings, bridges, highways, institutional buildings, and cost estimating, specifications writing. Administrative experience. Capable as project manager or chief engineer. C-2071-Chicago.

Positions Available

ASSISTANT SUPERINTENDENT, buildings and construction, degree in architecture or civil engineering and three years' experience in building construction, maintenance, architecture or engineering, one year of which should have been in a responsible administrative position. Duties will apply to routine matters of office administration and advice to individual supervisors in regard to coordination of custodial services, preventive maintenance schedules and special alterations. Salary, $6,750. New York Metropolitan area. W-9933.

CIVIL ENGINEER, familiar with hydraulics for prominent manufacturer of pressure piping. Must be experienced in design, construction, operation and maintenance of municipal water supply and must be capable of interpreting pipe requirements for the design of pipes for various field conditions and service. Work will be in association with research and production departments as well as national and local engineering and specification authorities. New York City. W-9914.

This is only a sampling of the jobs available through the ESPS. A weekly bulletin of engineering positions open is available at a subscription rate of $4.50 per quarter or $14 per annum, payable in advance.

STRUCTURAL ENGINEER, familiar with space frame work. No designing but more in consulting and surveillance. Will work out of N.Y. office, traveling in one or two southern states. Salary, $11,000-$12,000. W-9913.

STAFF ENGINEER, civil or industrial engineering graduate, with 10 to 15 years' experience covering estimating, office engineering, methods and procedures, job analysis, training and administration in municipal engineering and industrial construction including some oil field or refinery work. Salary, $10,000-$15,000. Middle East. F-9908.

TECHNICAL WRITER, 35-45, for the preparation of brochures, presentations, proposals, reports and similar tasks for a firm of engineers-constructors. Texas. W-9862.

CHIEF ENGINEER, graduate civil, 45-55, with from 10 to 15 years' experience in supervisory highway work. Must have poise and diplomacy and be able to work well with state and federal highway officials. Salary, to $15,000. East. W-9879.

STRUCTURAL ENGINEER, graduate civil, for design of structural items, i.e. scaffolding and foundations; also supervision of the job in the field. New York City. W-9859.

ARCHITECT, graduate, to 40; as chief architect for multi-plant operation. Should be registered in one or more states and able to qualify for registration in Minnesota. Must have industrial architectural experience and have worked with firm specializing in industrial office buildings. Must have appreciation for design and planning and have administrative ability. Salary, $12,000-$15,000. Employer will negotiate fee. Minnesota. C-8444.

DESIGNER, graduate C.E., to 35; three or more years' design experience in public works with emphasis on water and sewage. Duties include supervising four or five draftsmen; designing work on sewers, water distribution systems, sewage and water treatment plants; city streets and related public works. Must be good draftsman and willing to work on board as needed for a consultant. Salary, up to $10,000 depending on experience. Illinois. C-8435.

CIVIL ENGINEER-UTILITIES ENGINEER, degree and registration required, 25-50. Professional civil engineering work in design, location, installation and construction of public works or utilities projects. Work involves the application of technical engineering to performance or supervision of survey, design, maintenance and construction. Work available in public works projects and city utilities projects. Electrical experience preferred in utilities position and sanitary engineering experience preferably in public works position. Registration with five or more years' experience. Salary, to $8,673. Michigan. C-8434.

Bibliography on Airport Engineering

This Bibliography covers the period from 1938 through 1959, contains 184 pages, is arranged chronologically to reveal the technological advancement, and is classified into 26 groups to facilitate the location of pertinent references in a particular phase of airport work. The list price for this Bibliography is $8.00 with ASCE members and libraries receiving a 50% discount. Use this order form to obtain your copy.

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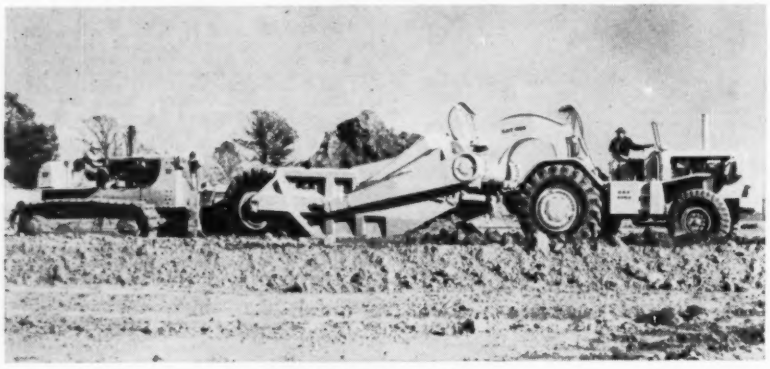
EQUIPMENT, MATERIALS and METHODS

Tractor-Scraper Combination

A NEW WHEEL tractor-scraper, featuring an exclusive torque divider power shift transmission, is the four wheel 630 Series A. It is powered by a new design, four-valve-in-head, diesel engine with a max rating of 420 hp and a flywheel rating of 335 hp. Other machine features include 28 ply 29.5 x 35 tires, "live" air actuated cable controls that reduce operator effort, an advanced design steering system, and a high degree of service accessibility.

A primary consideration in the design of the new tractor-scraper was the matched development of the torque divider power shift transmission with the new D343 Diesel Engine. To "shift," the operator need only move the selector lever to one of three speed range positions. Within each range, the most appropriate of three "drives" is automatically selected to meet changing power requirements.

Ease of serviceability was another of the prime design criteria for the new machine. All engine accessories can be repaired or replaced, including the oil pan, with the engine in the tractor. The engine can be removed with the torque divider transmission unit attached, permitting alignment prior to re-installation, or either unit can be handled independently. Other units are designed for easy accessibility for maintenance and repair. **Caterpillar Tractor Co., CE-2, Peoria, Ill.**



630A-482C Tractor-Scraper

The 482C scraper is of Lowbowl design and has a struck capacity of 28 cu yd and a heaped capacity of 35 cu yd. It is operated by an air actuated, double drum cable control. The unit is driven by a live power shaft directly off the engine, providing full cable control whenever the engine is running. Refinements to the basic Lowbowl concept permit corner voids to be filled without staying excessively long in the cut.

Anchoring System

A NEW VACUUM-TYPE anchoring system for masonry drilling equipment has been successfully employed at the Nurses' Dormitory of the Methodist Hospital of Central Illinois. No anchor holes were permitted, although specifications called for approximately 300 perfect holes to be drilled in finished lift slabs, and there was no ceiling against which the driller could jack the telescoping center post of his portable drilling machine. The slabs were 9-in. thick, of extra hard aggregate and heavily reinforced with rods varying from 1-in. to 1¼-in. dia. The holes were from 2 in. to 6 in. in dia and from 4 to 6 rods were encountered during the drilling of each. To accomplish the job, a portable diamond drilling machine is equipped with a vacuum pad —a flat aluminum pad resting in a molded rubber gasket which seals it to the floor when vacuum is applied. The pad is anchored to the drilling machine by two bolts which pass through the slots in the machine base and special hand knobs and washers. An electric motor and pump unit which plugs into any standard circuit quickly develops and maintains vacuum up to some 1,000 actual pounds. Cutting time per hole varied from 8 to 16 min, depending on the diameter of the hole drilled and the number of rods encountered. **Masonry Drilling Div., Wheel Trueing Tool Co., CE-2, Detroit, Mich.**

Overhead Piping

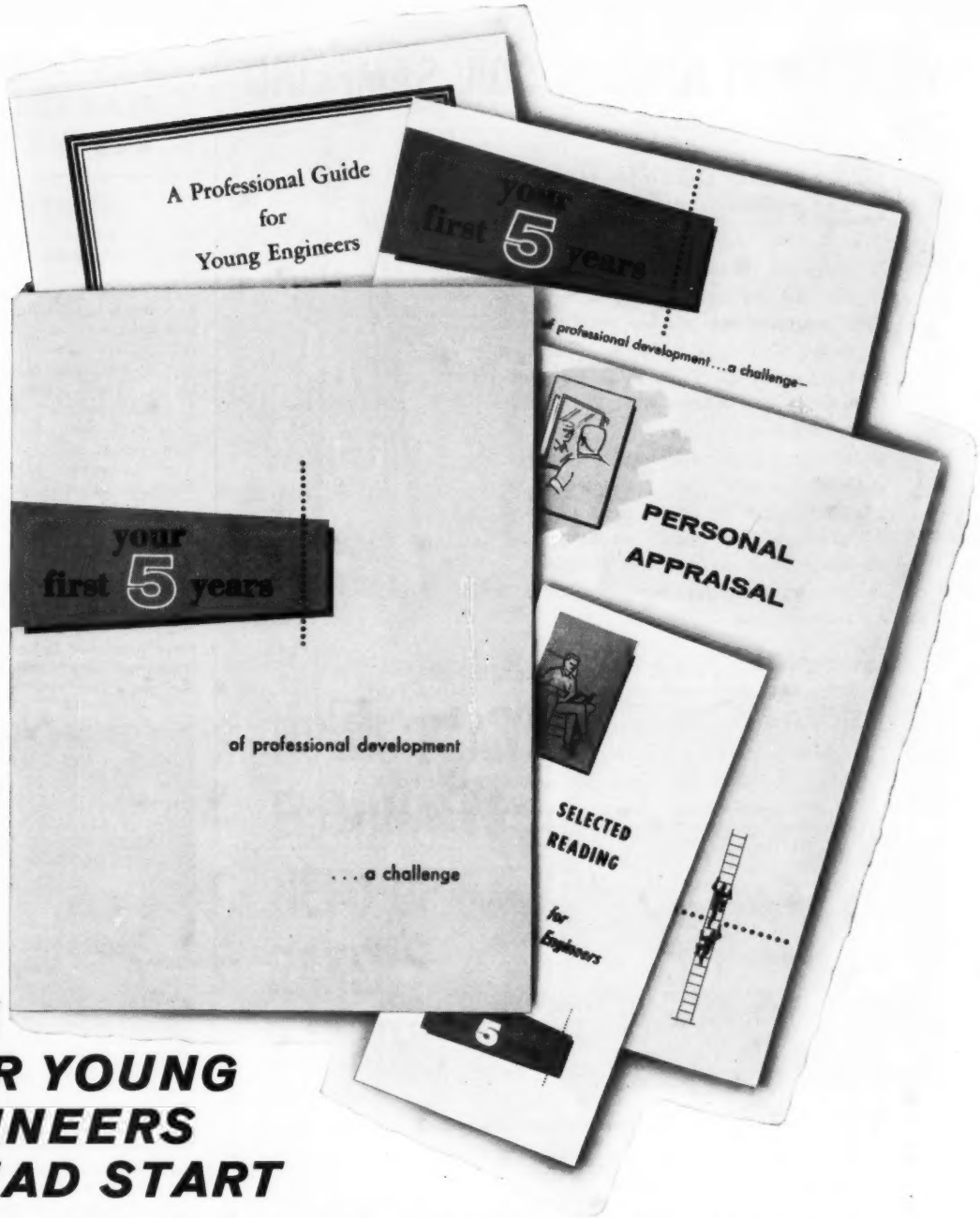
THIS PREFABRICATED PIPING SYSTEM for the overhead distribution of steam, hot water, process liquids and refrigeration lines is called Plasti-clad. It consists of the pipe and insulation covered with aluminum foil, over which are two wrappings of fiber glass cloth integrated within the Plasti-clad material. A final color coat of the material is applied to finish the unit. Standard color is green, however alternate colors are available. The entire system is factory prefabricated complete with expansion loops, anchor units, elbows and "T" units ready for installation. Straight run units are prefabricated in 21-ft lengths, pipe joints can be either field welded or threaded. Materials for insulating and sealing of field joints are furnished. Poles, hangers, saddles and other accessories are supplied at optional extra cost. **Ric-wiL, Inc., CE-2, Barberton, Ohio.**

Lightweight Heater

WEIGHING ONLY 35 LB, this portable heater is a practical unit for one man operators as well as large contractors. The dual handle design makes it easy to carry, to bring heat to workers where they need it. It goes anywhere, indoors or outside. One man can handle it easily through doorways, up and down ramps and stairs, on scaffolds and in other work areas. It circulates 50,000 to 75,000 BTUs of forced warm air every hour, enough to heat a 5-room house. After setting the dial for the amount of heat needed, a flip of the switch ignites the fuel and operates the heater. It runs on kerosene or No. 1 fuel and plugs into any 115 v AC outlet. An automatic fan cut-off control allows the combustion chamber to cool and then turns off the fan. It will run up to 14 hr on a 5-gal tank of fuel for only 6 cents an hr. **Master Vibrator Co., CE-2, 1752 Stanley Ave., Dayton 1, Ohio.**

Two Rocking Surfaces

THE TIGHT QUARTERS, clearance problem involved in the construction of a 700-ft long bridge for the Jones Falls Expressway in Baltimore, Md., was solved recently by the use of two double motion shoes. This curved bridge spans a small creek and three tracks of the Northern Central Railroad. Hemmed in by track and terrain, the piers on which the bridge superstructure rests are restricted in length. Instead of extending 40 ft from main girder to main girder, two of the piers are only half that long. Thus, at each of these piers, only one main girder rests on the pier and the other main girder must be supported by a special transverse floorbeam which cantilvers out beyond the end of the pier. One support of this floorbeam is the double motion shoe, located at the end of the pier. This type of construction requires that the floorbeam be free to deflect in two directions and therefore the shoe supporting it must allow this. The usual type of girder shoe permits a rocking motion in only one direction. These shoes, each weighing 12 tons and measuring 5 x 5 x 7 ft high, have two rocking surfaces, located at 90 deg to one another. The first motion absorbs the rocking in the length of the bridge, the second, at right angles to the bridge. **Bethlehem Steel Co., CE-2, Bethlehem, Pa.**



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A Sprague & Henwood pipe driving winch is your first requisite for normal soil sampling operations. For shallow holes there is the Model PD, and for the deeper holes, the more rugged Model PDH. Both models are furnished with a tubular steel derrick with telescoping rear legs permitting 10′ pulls. In addition to the skid mounting, there is also available a special trailer mounting that permits operation of the unit as either a skid or trailer-mounted unit. Write today for full particulars. Ask also for Bulletin #300 which illustrates and describes the complete S & H soil sampling line.

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Hotel Westward Ho, Phoenix, Ariz. April 10-14, 1961

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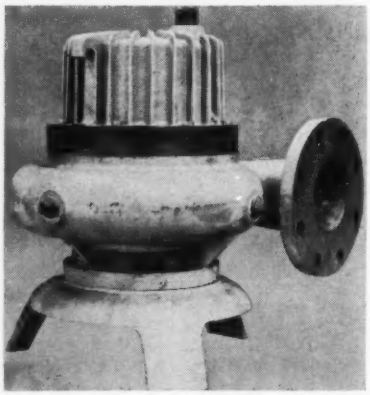
EQUIPMENT MATERIALS and METHODS

(continued)

Submersible Pump

NON-CLOG SUBMERSIBLE PUMPS newly announced by this company are designed to handle large solids and stringy materials, such as industrial material or wastes, raw or treated sewage, light sludge and slurries. These compact all-in-one pump and motor units are equipped with a one-piece cast iron impeller either in two-blade design or, where excessive clogging would otherwise be encountered, in a bladeless impeller design. The pumps come in 2-in., 3-in., and 4-in. sizes. The totally enclosed non-ventilated induction motor, available in a range of from ¾ hp to 7½ hp, has an oil-filled interior and finned exterior for rapid cooling in underwater operation. The one-piece motor and pump shaft is stainless steel for maximum resistance to corrosion. Installation in any sump or pit requires only one piping connection and a plug-in electrical



Non-Clog

connection. Typical applications of this pump include storm water drainage, small sewage lift stations, and general purpose sump drainage. **Fairbanks-Morse & Co., CE-2, 600 S. Michigan Ave., Chicago 5, Ill.**

High-Speed Paper

FOR USERS WHO WISH to achieve higher production without sacrificing print quality, there is a new diazo-blue paper offering 20-25% faster exposure speed with no loss in line-density. Normally, high-speed diazo papers sacrifice line-density for speed, but 214S is formulated with a new type of diazo compound that is characterized by broader light-absorption. Consequently, the new paper is exposed more rapidly without reducing density or contrast. It yields a bright blue image on a clean white background. It develops fully at printing speed and has excellent shelf-life and print-life. **Tecnifax Corp., CE-2, 195 Appleton St., Holyoke, Mass.**

Arc Welding Process

A NEW PROCESS, called Innershield, produces a significant change in speed that increases directly with the size of the joist being fabricated. The basically new principle involved is vapor shielding achieved with a tubular, fabricated electrode. The mild steel tube provides filler metal and contains material which furnishes all necessary ingredients for shielding, deoxidizing and fluxing. These include metallic salts which, when introduced into the intense heat of the arc, vaporize and expand. As they reach the isothermal cone surrounding the arc corresponding to their condensing temperature, they recondense forming a relatively thick vapor shield around the arc and molten metal preventing contamination by the surrounding atmosphere. **The Lincoln Electric Co., CE-2, 22801 St. Clair Ave., Cleveland 17, Ohio.**

Bucket Pump

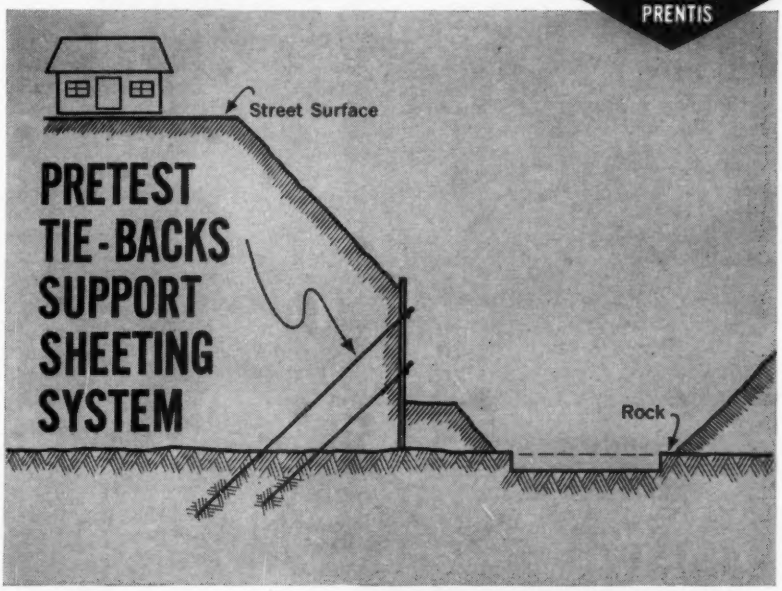
CAPABLE OF DISPENSING both fluid lubricants and greases, Model 1276 is a new, dual pressure bucket pump. It is designed primarily for lubrication of trac-roll bearings and features a dual ratio output-pressure combination that is easily changeable from high to low. With 150 lb of force on the handle in the low ratio position (6.8:1) over 2,000 psi lubricant pressure is developed. With the same force in the high ratio position (16:1) approximately 4,500 psi lubricant pressure is developed. A special dimple-tread foot pedal allows the operator to hold the pump steady for high pressure delivery. The lever handle is adjustable from high to low delivery by a knurled thumb screw and cradles into the carrying handle for portability. The pumping mechanism is of the differential type which delivers on both up and down strokes. **Lincoln Engineering Co., CE-2, 4010 Goodfellow Blvd., St. Louis 20, Mo.**

Flotation Tire

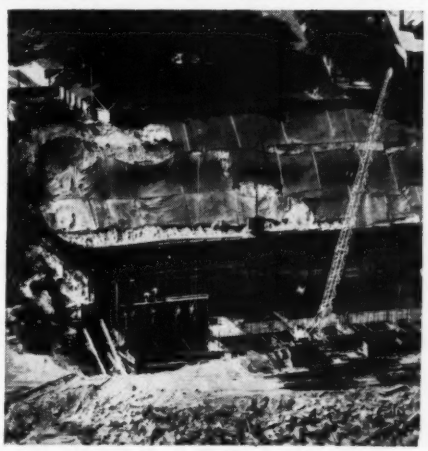
A TIRE COMBINING the off-the-road advantage of flotation tires with long mileage in highway service, has been introduced for use on transit-mix trucks, batch trucks and water buggies. The unique Flo-Track tire design incorporates a special highway tread on a flotation tire body. It will deliver up to 30,000 miles between new treads in average highway service. The new tires will permit mixer and batch trucks to move freely from highway to difficult off-the-road terrains, such as sand, muck or hillsides, without slowing down and without changing tires. In addition, single 18.50 x 20 Flo-Track tires may be used to replace standard duals on single or tandem rear axles. Carrying capacity of the single tire is 23,000 lb. Off-the-road flotation is provided by the flexible side walls, low operating pressures (40 lb front, 50 lb rear) and extra wide tread. The tires spread out under load to float over difficult soils and eliminate the need for crawler or winch truck assistance. **Harmo Tire & Rubber Corp., CE-2, 1800 West Fort Street, Detroit 16, Mich.**

Owner: City of Milwaukee
General Contractor: Bauer Construction Co., Milwaukee, Wis.
Engineers: Black & Veatch, Kansas City, Mo.

ANOTHER PROBLEM SOLVED BY SPENCER, WHITE & PRENTIS



NOVEL PLAN ELIMINATES NEED OF RAKER BRACING



170' x 65' lot is 80' below street level.

The above-pictured system of horizontal wood sheeting and soldier beams, extending 30 ft. to subgrade, dependably retained a heavy earth bank—without the customary bracing of raker beams.

An unusual method (on which patent application has been made) employed pretest wire tie-backs, on the exterior side of the sheeting, to provide the necessary support. Two tensioned wires were fastened to each soldier beam and, on the other end, were grouted into sockets in the bedrock.

Besides proving dependable and economical, the new method—one of many pioneered by Spencer, White & Prentis—has the further advantage of leaving the excavation free and clear for the contractor's operations.

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(continued)

Concrete Insert

DESIGNED PRIMARILY FOR suspending heavy loads from concrete walls and ceilings, a low cost u-shaped concrete insert can also be used to mount machinery and equipment to the plant floor. A heavy gauge, circular nailing plate holds the insert rigidly in place on the wood forms and is flush with ceiling, wall or floor after concrete is poured and forms are removed. The ⅝-in. nut floats in a sealed compartment within the insert to provide full adjustment during installation and also off-angle adjustment up to 10 deg. Special brazing at the edges of the nut compartment ensures a positive seal to keep out water or fine concrete. **Foster Illinois Corp., CE-2, 1238 West Harrison St., Chicago 7, Ill.**

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Latex Mortar Bridge Repair

THIS FALL THE Ohio Turnpike Commission repaired spalled areas on a bridge deck with a relatively new, experimental mortar, a portland cement composition modified with latex. Latexes are water dispersions of polymer (plastic) particles. The latex used on this job is reported to improve adhesion, tensile strength and flexural strength of conventional mortars by as much as 400%. Compressive strengths are doubled. This means that ½-in. resurfacings with the latex modified mortar are possible and that a high profile of physical properties can be expected. Surface preparation time was minimal and the repair of approximately 420 sq ft of spalled area was completed in 4½ hr. The maintenance crew found the latex modified mortar easy to place and screed. Traffic was kept off repaired areas for 72 hr. **The Dow Chemical Co., CE-2, Midland, Mich.**

Hole Cutter

A GREATLY SIMPLIFIED and less expensive machine for cutting 90-deg holes in pipe, tanks and flat plate is the Model ST Hole Cutter. Three sizes permit cutting perpendicular holes up to 18 in. in dia without cams, patterns or layouts. It is a lightweight machine that may be used with electric drive or may be completely hand operated in the field. Cutting is accomplished with an oxygen, acetylene torch arrangement which is reported to overcome many of the difficulties encountered with previous methods. Edges are clean, burr-free and have excellent weldability. Grinding is not necessary as little slag is accumulated. The machine is powered through its cycle with a variable speed electric motor at the correct speed relative to the thickness of the metal. When operated by hand, cutting speed is controlled by the operator. **Steffan Manufacturing Corp., CE-2, 1585 So. Lincoln Ave., Salem, Ohio.**

Low Cost Feeder

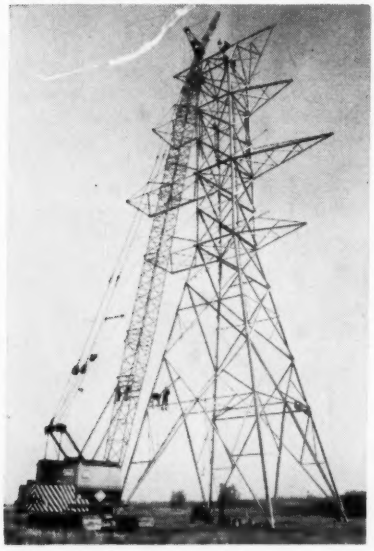
THIS NEW TYPE of pneumatic vibratory feeder is designed to sell for a fraction of the cost of traditional models. According to the manufacturer, it uses a one-piece long stroke air vibrator. In a typical installation, the unit feeds powdered asphalt (⅛ in. minus) into a pulverizer at the rate of approximately 12,000 lb per hour using a 6-deg angle of slope. Operating air pressure is 35 psi. A solenoid valve controls air to the vibrator and gives a positive cut-off to eliminate dribble from the feeder. It can deliver more lb per hour when the installation calls for it. The feeder is recommended for cereals, foodstuffs, chemicals, and other types of bulk materials. **National Air Vibrator Co., CE-2, 435 Literary Road, Cleveland 13, Ohio.**

Alloy Steel

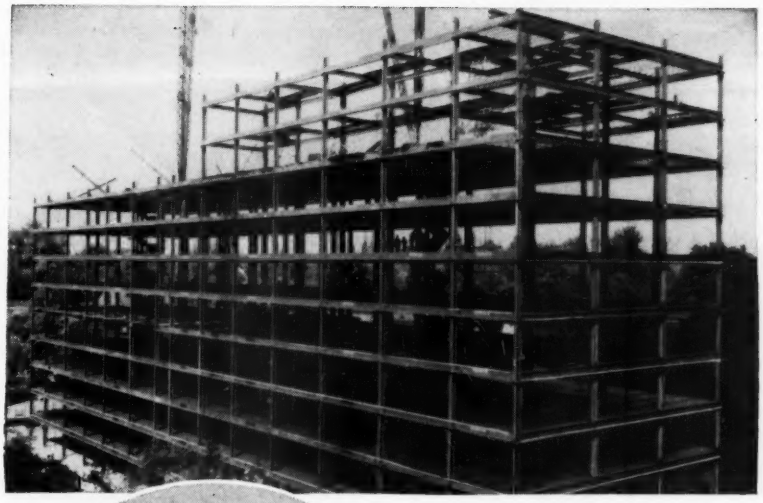
SIGNIFICANT SAVINGS in the fabrication of stronger, lighter steel structures and equipment are promised by a new, low-cost constructional alloy steel. Designated as "T-1" Type A steel, the alloy is available in quenched and tempered plates and bars ranging from $\frac{3}{16}$ to 1-in. thick inclusive. In this thickness range, it has the same 100,000-psi minimum yield strength as "T-1" steel, which was introduced in 1953. Also, in thicknesses up to 1 in. inclusive, the new material and the original "T-1" steel exhibit the same degree of toughness, weldability and resistance to impact and abrasion. However, this material costs significantly less because of differences in chemical composition. **U. S. Steel Corp., CE-2, 525 William Penn Place, Pittsburgh 30, Pa.**

Crawler-Mounted Crane

THIS SPECIAL CRANE, designated the Type 65-SC, has a lifting capacity of 55 tons with a 40-ft boom at 12-ft radius. The boom can be extended to 180 ft for such work as boosting concrete buckets



on multi-story building construction. Significant features and advantages of the new crane include: precision air-operated main and auxiliary controls that provide ease of operation and good handling ability; long wide crawlers that afford large ground bearing capacity for special crane service; crawler side frames and counterweight that can be removed easily to meet clearance requirements and load restrictions when trailing; and a choice of gasoline, diesel or electric drives, with torque converters, providing flexibility for virtually any application and ample power for heavy lifting. The unit is ruggedly constructed to provide long service life. Construction features include heat-treated ground shafting, machine-cut gear teeth, and booms built of high-strength tubular welded alloy steel. **Construction Equipment Div., Baldwin-Lima-Hamilton Corp., CE-2, Lima, Ohio.**



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CE 2-61

Aluminum Grating Facades

NOW A COMPLETELY NEW material has been added to the design of building facades: color anodized aluminum form of grille or grating. For example: a hollow type of aluminum plank has been developed on which almost any design of triangles, rectangles, and squares can be punched out. This plank can then be anodized virtually any color, then specially colored metal inserts can snap in behind the cut-outs for a wide range of mosaic designs and colors. Regular rectangular grating can be redesigned with cross bar and bearing bars on almost any center for strikingly unusual effects. The same redesign can be done with riveted grating, or combinations of both types. **Borden Metal Products Co., CE-2, Box 172, Elizabeth, N.J.**

Roadbed Material

SEVERAL FACTORS HAD to be considered when selecting roadbed material for the subway opened last year connecting the New Senate Office Building and the Capitol, in Washington, D.C. Among them was the architect's decision that the unsightly bolt heads protruding from the concrete roadbed up through the mechanism that holds the rails in place should be hidden. To do this, he wanted to use a material which would adhere to the concrete in relatively thin sections, and which would also provide sound-deadening qualities. After evaluating the many products available, the contractor selected Laykolk Heavy-Duty Mastic, Specification G-15. Among the reasons for this decision were: Laykold mastic is easily mixed; it hard-trowels to a dense, smooth surface, and, when cured, provides a hard, durable shock-resistant finish. **American Bitumuls & Asphalt Co., CE-2, 320 Market St., San Francisco, Calif.**

Alarm System

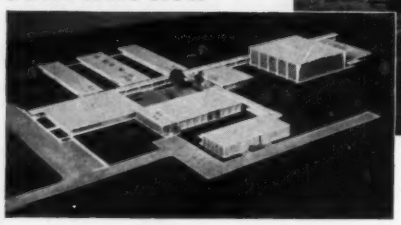
A REVOLUTIONARY NEW FIRE and smoke detector, called Pyr-A-Larm, can signal warning of an incipient fire condition even before the visible smoke, flame or heat necessary to trigger ordinary detectors. All fires give off large quantities of invisible particles. When these microscopic particles enter the sensitive sampling chamber in the detector, they interrupt the flow of tiny electrical current. The instant this happens, an alarm signal is flashed to a power unit where automatic controls can call the fire department, shut off fans, actuate extinguishing systems, or perform any other desired function. The cost of operating an entire system in a medium sized building is about the same as that for an ordinary 25 watt light bulb. **Pyrotronics, A Div. of Baker Industries, Inc., CE-2, 10 Empire St., Newark 12, N.J.**

Heavy Bodied Ink

A NEW CONDUCTIVE INK for printed circuits has been developed. Said to be a smooth, heavy bodied conductive black ink that screens sharply, it dries in ½ to ¾ of an hour. The new product is described as a mild solvent base material of low odor that dries to a tough resistant coating and adheres to a wide variety of materials. When deposited by screen process through an 8xx mesh, a conductivity rating of 3,000 to 5,000 OHMS per in. can be anticipated. **Advance Process Supply Co., Inc., CE-2, 2315 West Huron Street, Chicago 12, Ill.**

Another Example of Prescon's Advantages...

Savings and Long, Clear Spans Gained in School Construction



Robstown High School, Robstown, Texas
Architect and Engineers: Donnelly & Whittet, Corpus Christi

The Gym for Robstown High School has 117 ft. span (outside to outside of column) using The Prescon System to post-tension the prestressed concrete three hinged arch. Savings over conventional methods approached five figures. T. Y. Lin observed that this is one of the most outstanding structures in the country. Of the other buildings, four made use of The Prescon System in a cast in place beam and slab structural system.

Savings, design flexibility, and materials that are readily available are possible when you plan with prestressed concrete using The Prescon System of post-tensioning. For details of this and other types of structures write or contact a Prescon representative.

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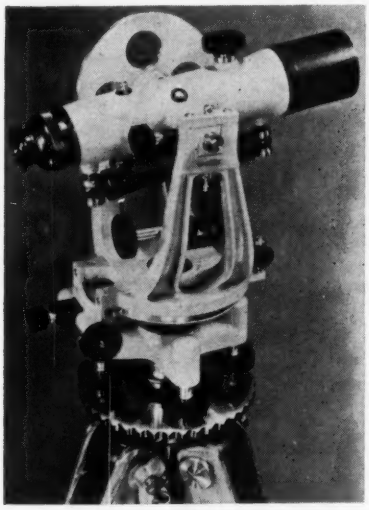
Contractor's Transit

A HIGH-QUALITY, highly-accurate transit for the contractor, architect and engineer has been added to this company's line of engineering instruments. Known as the Model No. 287 Contractor's Transit, the instrument features a telescope 8½-in. long that transits, swinging through a complete vertical circle. This feature increases the range of vertical angles, makes possible prolonging lines and also simplifies checking adjustments. It is possible to read horizontal and vertical angles to five min by vernier.

The instrument is of U-frame construction and comes with a carrying case. Any standard tripod can be used. All lens surfaces of the 287 are hard anti-reflection coated. Magnification of the telescope is 18½x. A covered glass reticle with cross lines, in dust-free focal plane, is a feature of the telescope. Among the instrument's applications are: precise construction of foundations, piers and walks; laying of drainage and sewerage lines;



landscaping; building construction; and planning outdoor recreational facilities. **Engineering Instruments Div., W. & L. E. Gurley, CE-2, 514 Fulton Street, Troy, N. Y.**

Form Release Agent

FORM COMPOUND C IS a pre-mixed, easy-to-use form sealer and release agent for concrete and allied products. Shipped as a slurry, it mixes readily in cold water even when high in mineral content. It contains a surface active agent for a more uniform coating on concrete forms. The compound is a positive bond breaker which neither reacts chemically with concrete nor interferes with proper cure. Use of the new form release agent permits painting of concrete surfaces without special preparation. It seals and preserves plywood and lumber forms for maximum use, and is equally effective in protecting steel, aluminum and fibreglass or resin-coated forms and molds. Shell Oil Co., CE-2, 50 West 50th St., New York 20, N.Y.

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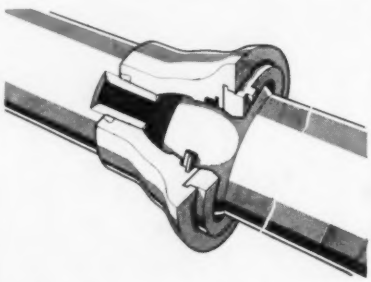
EQUIPMENT MATERIALS and METHODS

(continued)

Boltless Pipe

A SIMPLE, RUGGED, bottle-tight flexible joint for cast iron pipe, which is assembled without the use of bolts, is provided with Usiflex® pipe. Locked against pull-out, the joint is ideally suited for underwater installations where the high cost of equipment and manpower emphasize the importance of ease and speed of assembly as well as the utmost in reliability. The L-shaped gasket is self-sealing rather than having a seal that depends on an exterior force from a gland. A heavy section steel retainer ring with lugs is inserted in the internally lugged bell and turned so that the lugs interlock and lock the joint against pull-out. The pipe is cast centrifugally, in lengths of 18 ft,



with a ball on one end and plain end on the other. The bell is cast separately of high strength cast iron. The back of the bell is internally threaded and screwed on the threaded plain end after the retainer ring is slipped over the barrel of the pipe. **Publicity Dept., U.S. Pipe & Foundry Co., CE-2, 3300 First Ave. North, Birmingham 2, Ala.**

Converter

A NEW RETRACTABLE AXLE converts single axle tractors into tandem units for greatly increased highway payloads. Designed to fit on any standard single axle tractor, the new unit can be installed in a few hours by regular shop personnel. With it, van and dump operators can increase their existing single axle tandem capacity at a fraction of the cost of buying new units. Further savings have been designed into the unit by incorporating air-lift cylinders which pick the axle up off the road when the unit is lightly loaded or on an empty return run. In this manner, the operator saves money on the tire wear and extra fuel that would have occurred if the tractor were a standard tandem unit. The units have been field-proved on hardest quarry and construction projects under all types of terrain and weather conditions. **Clement-Braswell, Inc., CE-2, P.O. Box 696, Minden, La.**

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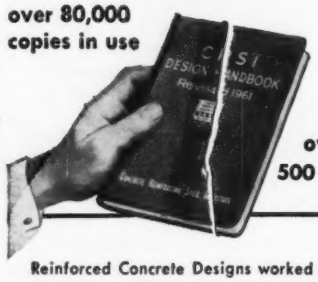

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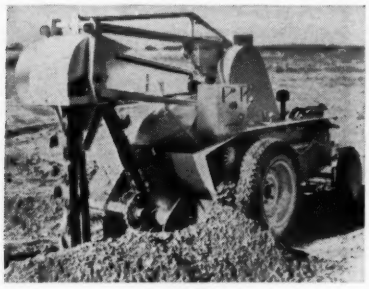
EQUIPMENT MATERIALS and METHODS

(continued)

Utility Trencher

A HEAVY DUTY utility trencher with a vertical boom has been announced. The boom enters the ground at a vertical angle which enables the operator to work flush to walls, curbs and sidewalks. Less cross-sectional area of the boom in the ground facilitates steering. Known as the Century Trenchit, the unit is reported to eliminate a trailer for transport. It quickly hitches to a car or pick-up by means of hydraulic controls and can be safely towed from job to job at highway speeds. For shorter distances at the job site, the self-propelled unit has a walking speed

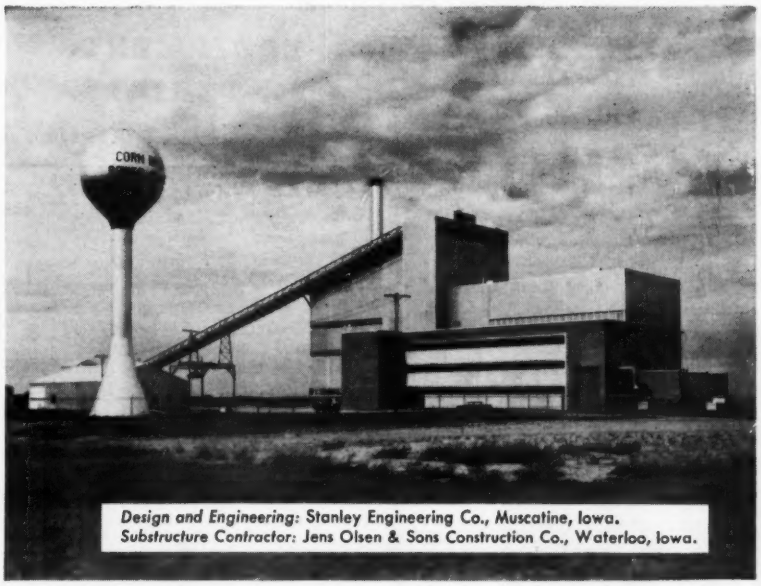


Trenchit

of up to 2½ mph. All of its operating functions are hydraulically controlled which provides smooth, easy handling with maximum safety. Only one man is required from hitch to hitch. The Trenchit digs 4 to 12-in. wide with variable, selective depths. **Century Engineering Co., CE-2, Waukesha, Wisc.**

Construction Hoist

KNOWN AS THE JUMBO, this sky-touching portable construction hoist offers automatic features and hydraulic power. The unit's combination of power, strength and smooth operation enable it to provide 3000-lb capacity for the first time in portable construction hoist history. This load can be swept up on the large 6-ft 6-in. x 5-ft 6-in. platform or in the concrete bucket with extreme economy in cost and manpower. The 30 hp Wisconsin air-cooled engine with locking ignition and Stellite valves makes Jumbo a tower of strength.The unit is of particular interest to companies that customarily handle short jobs, or require frequent shifts of hoist from place to place. Without having to be disassembled, it can be towed at any legal speed by an ordinary vehicle. This towability is possible because of the precision balancing over the wheels and the tower's rigidity, which allows it to ride without swaying. **Tubular Structures Corp. of America, CE-2, 4560 Sperry St., Los Angeles 39, Calif.**

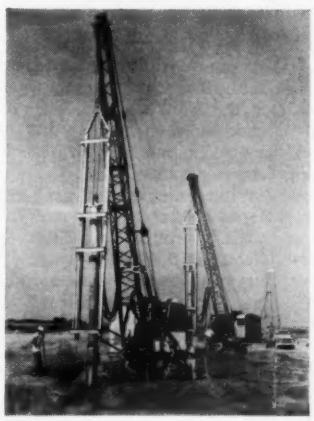


Design and Engineering: Stanley Engineering Co., Muscatine, Iowa.
Substructure Contractor: Jens Olsen & Sons Construction Co., Waterloo, Iowa.

Vibroflotation®

was used to compact sandy soil for powerhouse in Iowa.

The new 33,000 KW power plant of Corn Belt Power Cooperative, Spencer, Iowa, was built on sand compacted by Vibroflotation. 680 compactions were made to a depth of 17 feet below the footings to obtain a minimum 70% relative density throughout the building area and 85% relative density under the turbine-generator foundation.



Vibroflots compacting soil at Spencer, Iowa. About 2½ cu. yd. of sand fill was required for each penetration.

In addition to a substantial cost savings, Vibroflotation provided an effective solution to the problem of eliminating foundation settlement, even under exceptionally heavy dynamic loads.

Additional savings were realized through elimination of all form work for footings.

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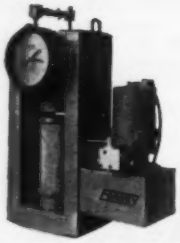
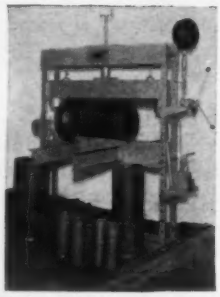


MODEL FT-30 HEAVY-DUTY PORTABLE CONCRETE TESTER

Latest addition to a complete line of portables, the FT-30 brings laboratory performance right to the job site. Self-contained power unit eliminates cumbersome hose and manual pumps. Loading speed is completely variable for accurate conformance to current ASTM standards.



MODEL PT-15 TILE TESTING MACHINE

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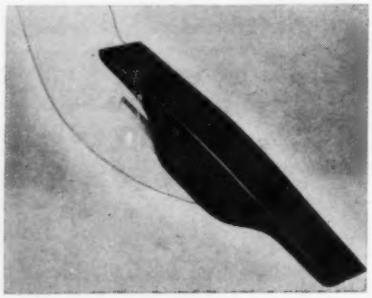
EQUIPMENT MATERIALS and METHODS

(continued)

Scarifier Point

KNOWN AS "Twin-Tip," a scarifier tip for road graders features a point on each end, which allows it to be easily reversed on the scarifier shank when the initial point becomes worn. As a result it offers double the normal life of conventional replacements. Made of special alloy, shock-resistant steel, the tips are drop forged and differentially heat treated to provide maximum dependability. Wedge-



"Twin-Tip"

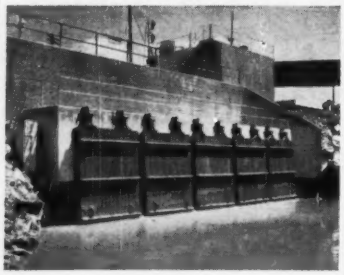
action channel design securely locks the part in position and insures a firm grip on the shank regardless of operating conditions. **Allied Steel & Tractor Products, Inc., CE-2, 7835 Broadway, Cleveland 5, Ohio.**

Decorative Wall Panels

A LOW-COST decorative use of concrete wall panels was achieved by architect John L. Turner & Assoc., Jackson, Miss., on the front and side walls of a school auditorium, by means of a relatively new technique. The aggregate remained exposed and colored cements produced an interesting and dramatic diamond-shaped pattern. The design for these panels is geometric, but many different effects are possible by varying textures, colors and designs. The panels were made face down on concrete forms, coated with Rugasol F. The triangular shaped portions on the face were made by separating the sections with wood strips. Concreting is achieved in two operations. First, the facing part of the panel is made, using different colored cements for the different areas. Then a 2-in. covering thickness is cast over the first part, to bind together the entire panel. Plastiment Retarding Densifier was used in all the concrete to keep it plastic long enough so that all the parts could be readily joined together and to assure good bond between the many segments. After casting, the panels were left in the

(Continued on page 121)

TIDE GATES



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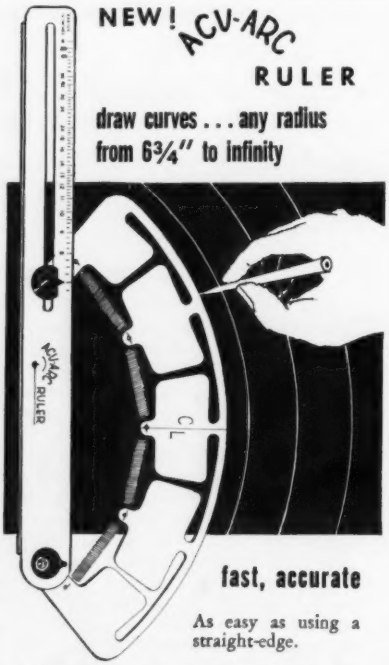

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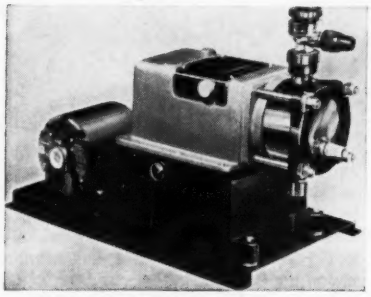
Barstow, Calif., *Dist. Inquiries Invited.*

forms for 1½ days, then tilted and lifted out. The surface mortar was brushed and hosed off with water, exposing the aggregate. The Rugasol retarded about ⅛ in. of the surface mortar, without penetrating below. **Sika Chemical Corp., CE-2, Passaic, N.J.**

Metering Pump

DESIGNED FOR FLEXIBILITY in industrial applications, a low-capacity metering pump has interchangeable heads of Tyril of Penton plasties with a variety of trim materials for custom metering of a wide range of corrosive liquids. Available with a single head (Series A-747) or double heads (Series A-748), maximum capacities are 250 and 500 gpd respectively. Maximum pressure is 100 psi for both models. The dual-head model has separate stroke-length adjustment and indication for each head. Thus, two chemicals can be proportioned simultaneously, or twice the volume of the single model can

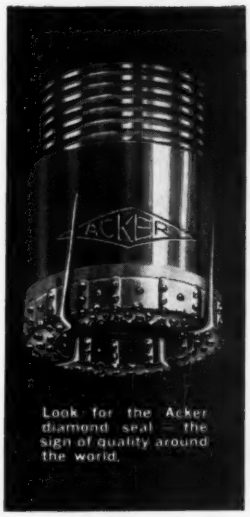


be handled with one pump. Stroke length is adjustable over a 10:1 range while the pump is operating. Pumping is by positive-displacement diaphragm action. There are no stuffing boxes, shaft seals, or packing glands to leak. Short stroke length and slow stroking speeds assure long diaphragm life. **Wallace & Tiernan Inc., CE-2, 25 Main Street, Belleville 9, N.J.**

Rafter Layout Tool

FOR THE FIRST TIME a tool has been developed for use in laying out building roof rafters. Because of its features, it is no longer necessary to rely on calculations and step-by-step measuring for figuring cuts and lengths of rafters. The design enables the user to make the necessary cuts on even the most complicated layout with accuracy and with a single setting of the tool. For example, a 4 and 12 pitch is obtained by moving the "Common" arrow to No. 4 on the tool. This setting gives the ridge, seat, and eaves cuts for common rafters of this particular slope. Hip and valley rafters are laid out by moving the "Valley" arrow to No. 4 (for a 4 and 12 pitch). All side cuts for jack rafters are obtained by the pointer on the plate. Made from durable steel, this tool will provide much needed practical help in any type of roof construction. **All-States Sales and Mfg. Co., CE-2, 2610 Bay Road, Redwood City, Calif.**

acker **BEST DEAL IN DIAMOND BITS**



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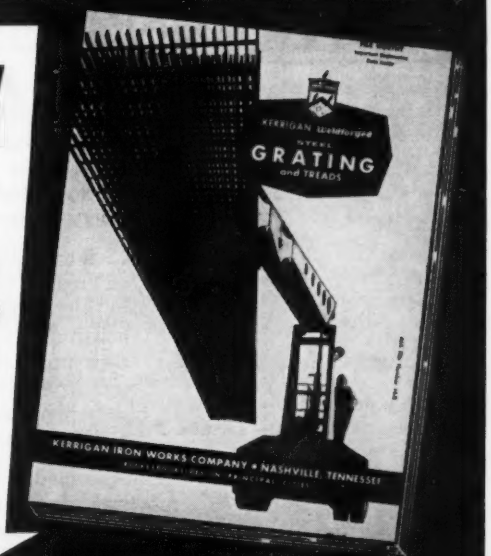

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EQUIPMENT MATERIALS and METHODS

(continued)

Tug-Dozer

A THREE-WHEELED tractor designated Series K-53 Tug-Dozer is the "smallest" member of a new line of "Pacemaker" diesel-electric tractors designed for heavy-duty pushing and dozing. The machine features an all-wheel drive, with individually powered electric wheels for propulsion. Each wheel has its own DC electric motor and gear reduction built inside the rim. Electric generators are coupled to the machine's 420 hp diesel engine to power the motors. The tractor weighs approximately 80,000 lb and rolls

on 75-in. dia tires. A modification of this machine, the Series K-53F, is equipped with 89-in. tires and is intended especially for operation in sand and other areas where high flotation is necessary. **R. G. LeTourneau, Inc., CE-2, 2399 South MacArthur, Longview, Texas.**

Plastic Coating

A PROCESS, PEELCOTE, has been developed to protect bare or epoxy-coated metal wall panels. This plastic coating is roller-applied in liquid form to the finished sheet surface and cured by baking to a dry film 1.25 mils thick. It protects the finish of the metal panels during forming, packaging, shipping, on-site storage and erection, and is easily stripped away after erection, leaving the surface free of fingermarks, dirt and scratches. **Elwin G. Smith & Co., Inc., CE-2, 1956 Williams, Pittsburgh 2, Pa.**

Gas Burners

TWO NEW COMPACT, light weight LP-Gas "Liquid" Burners are the CW-2 Jet Flame Burner with 600.000 B.T.U. capacity (weighing only 3½ lb) and the CW-3 Jet Flame Burner with 1.000.000 B.T.U. capacity (weighing only 5½ lb). These burners are used wherever intense, even, immediate heat is required. They out-perform bulky, slow, troublesome oil-burners. No pumping or preheating is necessary. They will stay lit under any conditions, and are extremely simple to operate. They perform at full capacity on any size container of bottled gas until the last drop is gone. **Corwill International Corp., CE-2, P.O. Box 1030, Cedar Rapids, Iowa.**

Literature Available

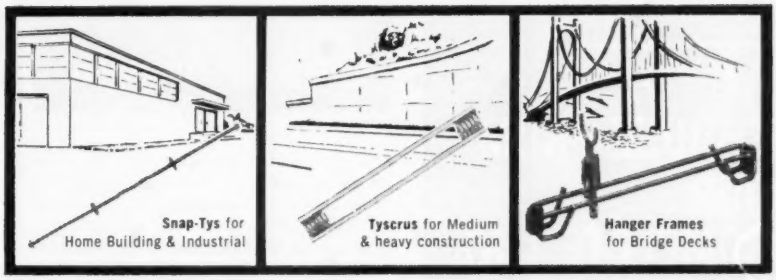
STEEL—"Craftsmanship in Steel" is the title of the brochure describing this company's products and world wide coordinated services. The illustrated publication tells of its capabilities in design, fabrication and construction of structures to serve leaders in the fields of nuclear power, aerospace, chemistry, petroleum, cryogenics, hydroelectric power, pump and paper, and saline water conversion. **Chicago Bridge & Iron Co., Advertising Dept., CE-2, 332 South Michigan Ave., Chicago 4, Ill.**

INCINERATOR SELECTOR—Just issued is a pocket-size "Incinerator Selector" which simplifies the selection of the correct incinerators for various types of installations. In appearance and operation, it is somewhat like a slide rule, and is a valuable time-saver for quickly determining not only the type but the size incinerator recommended for such applications as apartment houses, cafeterias and restaurants, clubs, department stores, hotels, hospitals, etc. **Morse Boulger, Inc., CE-2, 80 Fifth Avenue, New York 11, N. Y.**

TRACTOR-SCRAPER—The 20 cu yd (heaped) capacity Model C Speedpull is described in this 16-page, multi-colored bulletin. The booklet contains a full and complete description of this six wheel tractor-scraper combination, and points out many of the machine's features which prove its adaptability to long-haul earthmoving. **LeTourneau-Westinghouse Co., CE-2, 2301 N. E. Adams Street, Peoria, Ill.**

ALUMINUM GRILLES—An Anotec® Architectural Anodized Aluminum Grilles manual provides complete product specifications on the wide choice of standard geometric patterns, dimensions and colors in which this modern material is now available. Outstanding industrial, commercial and housing design uses, in new construction and modernization, are shown in full color and black and white. The construction details of curtain walls, a solar screen, walkway, etc., are fully illustrated with technical drawings. **Klemp International, CE-2, 1132 West Blackhawk St., Chicago 22, Ill.**

CONCRETE CONSTRUCTION—Advantages and new design techniques of monolithic light weight concrete joist construction are described in a 68-page manual (4002-C). The wire-bound manual contains isometric details and cross section drawings of the company's concrete joist construction with tabulated data for steeldomes, flange forms, adjustable forms and long forms. It is profusely illustrated with details and on-the-job construction photos. It also describes related items such as reinforcing bars, spirals, welded wire fabric, etc. **Ceco Steel Products Corp., Dept. A, CE-2, 5601 West 26th Street, Chicago 50, Ill.**



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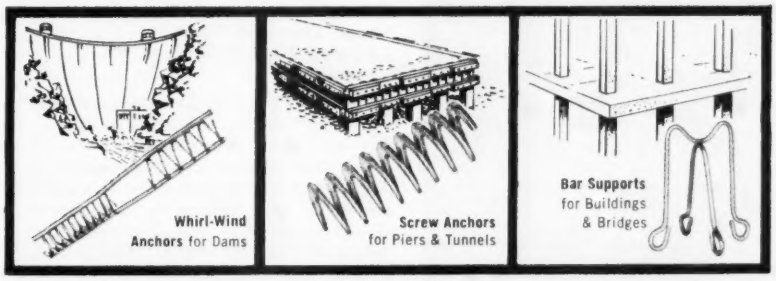

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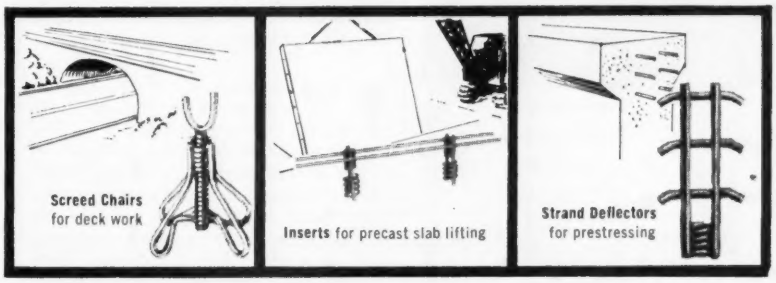

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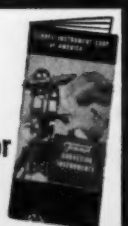

FENNEL INSTRUMENT CORP. of AMERICA
50 Colfax Avenue, Clifton, N. J.

Literature Available

SOIL STABILIZATION—The use of phosphoric acid as a soil stabilizer in highway construction is described in a 13-page bulletin (I-186). It covers subgrade and base course stabilization, field and laboratory tests, and properties of the product. Illustrated with photographs showing application methods, several charts are included showing various laboratory test results. **Monsanto Chemical Co., Inorganic Chemicals Div., CE-2, 800 North Lindbergh Blvd., St. Louis 66, Mo.**

CONCRETE FINISHER—Designed for road and airport paving, but versatile enough for many other construction operations, a new self-widening concrete finisher is described in bulletin No. CF-100. Among the many new features in the unit is simplified operator control through utilization of centrally located electric push buttons and hydraulic operating levers. Also, widening action of the machine is accomplished during finishing operations when necessary. **Sales Promotion Dept., Blaw-Knox Co., Construction Equipment Div., CE-2, Mattoon, Ill.**

WIRE REINFORCEMENT—"Machine Placement of Wire Mesh Reinforcement in Single-Lift Concrete Pavement" is the title of a bulletin describing construction of a section of Interstate Highway No. 5, south of Albany, Ore., on which the contractor used a machine of his own design to place the wire fabric reinforcement in a single lift of concrete. Write on letterhead. **Dept. 246, Wire Reinforcement Institute, CE-2, National Press Building, Washington 4, D. C.**

DEWATERING SYSTEM—A new catalog describing this company's wellpoint system of dewatering, stabilizing, and preventing mass movement of wet soil during excavation, has just been issued. With many on-the-job pictures, it describes installation equipment, jetting pumps, jetwell pumps, pipe and fittings, special pumps, wellpoints and wellpoint pumps. It also shows many types of projects where predrainage by these systems has cut costs and helped solve construction problems. **Moretrench Corp., CE-2, Rockaway, N. J.**

LO-LOSS FLOW TUBE—The Lo-Loss Flow Tube is a differential producer with low head loss and high recovery. Advantages over other differential producers include: high sustained metering accuracy, short laying length, low cost, flexibility, and choice of insert or full length tubes. They come in a wide choice of materials and are serviceable for water, sewage, sediment bearing liquids, trade wastes, acids, alkalies, air or gases. This bulletin includes a chart of permanent pressure loss of primary elements. **Burgess-Manning Co., Penn Instruments Division, CE-2, 4110 Haverford Ave., Philadelphia 4, Pa.**

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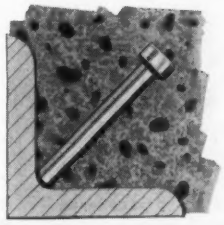
From the MANUFACTURERS

FOREIGN INTERESTS: Kaiser Engineers & Constructors, Inc., of Oakland, Calif., has been appointed by The Steel Corporation of Iran to assist the corporation in carrying out its responsibilties in the planning, implementation and completion of their proposed steel plant facilities . . . The Crucible Steel Co. of America, through its wholly owned subsidiary, World Crucible, Ltd., has established an Australian company, Crucible Steel Australia Pty. Ltd., to distribute the full line of specialty steel products . . . The Master Builders Co. has formed, with the Nippon Soda Co. Ltd., a new company in Tokyo, Japan. The firm, "Nisso Master Builders Kabushiki Kaisha," will manufacture and market Master Builders products in Japan and the far east . . . Caterpillar Tractor Co. has announced the formation, in Geneva, Switzerland, of a subsidiary, Caterpillar Overseas S.A., to take over the selling and servicing of Caterpillar products outside the Western Hemisphere . . . Pittsburgh-Des Moines Steel Co. has broken ground for a new steel fabricating plant to be erected near Guatamala City. Pittsburgh-Des Moines Steel, Tissot of Colombia, South America, and others have formed a new company, TIPIC, S.A., to provide many of the metal fabrication requirements of a line of products for the common market of Central America . . . **AWARDS:** International Harvester Company's Construction Equipment Div. has been awarded a citation by the U. S. Army Engineer School in recognition of the company's long association with the school in the development of training programs for military use of crawler tractors . . . Minneapolis-Honeywell Regulator Co., for its current advertising campaign advancing the professional status of the consulting engineers profession, has been presented the 1960 Merit Award of the Consulting Engineers Council . . . **CONTRACT AWARDED:** Sverdrup & Parcel Engineering Co., St. Louis, Mo., has been awarded a general construction contract covering a major modernization and expansion of the main plant of The Mueller Co., Decatur, Ill. . . . **WORLD'S FAIR POOL:** Three firms, Ebasco Services, Inc., Vandenburg-Linkletter Associates, Inc., and Walter Kidde Constructors, Inc., have announced the formation of V-E-K Associates, Inc., to provide all-inclusive exposition services and facilities for exhibiters at the 1964-65 New York World's Fair . . . **NEW BUILDING:** A new direct factory warehouse to service Bay area users of industrial fasteners has been opened in San Francisco by Russell, Burdsall & Ward Bolt and Nut Co. The new warehouse building will contain 1000 tons of stock and a complete inventory of fastener products . . . **BRANCH OFFICE:** Sprague & Henwood Inc. recently announced the opening of a Southwestern Branch in Tucson, Ariz. . . . **NAME CHANGE:** Koh-I-Noor Pencil Co., Bloomsbury, N.J., one of the world's oldest manufacturers of drafting supplies, has changed its corporate name to Koh-I-Noor, Inc. The change was made in view of the diversified range of drafting and writing products the company now manufactures in addition to pencils and leads . . . **SALES REPRESENTATIVE:** Walker Process Equipment Inc., Aurora, Ill., has been appointed to handle sales in the sanitary enginering field of blowers manufactured by Spencer Turbine Co., Hartford, Conn. . . . The Charles Bruning Co., Inc. has concluded an agreement to become exclusive distributor in the U.S. of a line of surveying instruments manufactured by Cooke, Troughton & Simms, Ltd., York, England . . . . **RESIGNATION:** The resignation of L. Byron Cherry as General Manager of the Ozalid Div. of General Aniline & Film Corp. has been announced. Harold W. Metcalf, manager of Planning and Assistant to the General Manager of Ozalid, will serve as acting General Manager until Mr. Cherry's replacement is announced . . . **APPOINTMENTS:** Raymond Concrete Pile Div. of Raymond International, Inc., has named four men to the newly created positions of regional managers: J. P. Cummins for the East with headquarters in New York, C. E. Simmons for the Midwest, C. J. Van Horn for the South, and C. R. Graff for the West . . . Arnold R. McLain has been appointed General Manager of the Yuba Heat Transfer Div., Yuba Consolidated Industries, Inc., Honesdale, Pa. . . . Mr. Frank G. Fearon of Falls Church, Va., has been appointed Manufacturer's Representative for Richmond Screw Anchor Co., Inc. in the Ohio, Indiana and Michigan sales area.

SMALL DETAIL?



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PROCEEDINGS AVAILABLE

December

2694. Discussion of Proceedings Paper 2146, 2275, 2412, 2417, 2513, 2592. (HW) L. R. Schareman on 2146. Nathan Cherniack on 2275. Jacob Feld, W. H. Campen, L. G. Erickson, and J. R. Smith on 2412. Keneth M. Hoover, S. D. Forsythe, Nathan Cherniack on 2417. Robert L. Morris James S. Burch on 2513. Bob M. Gallaway on 2592.

2695. Discussion of Proceedings Paper 2153, 2283, 2530. (IR) M. C. Boyer on 2153. Robert O. Thomas on 2283. Lee Chow on 2530.

2696. Discussion of Proceedings Paper 2210, 2215, 2320, 2431, 2501. (SM) Thomas H. Thornburn and Wesley R. Larsen on 2210. W. F. Swiger on 2215. Aris C. Stamatopoulos on 2320. John L. Rae on 2431. A. L. Little, N. R. Morgenstern, and V. E. Price on 2501.

2697. Discussion of Proceedings Paper 1974, 2163, 2305, 2350, 2384. (ST) E. F. Ball and J. J. Higgins on 1974. Charles E. Massonnet on 2163. A. Hrennikoff on 2305. Charles E. Massonnet on 2350. A. Zaslavsky and Paul Zia on 2384.

January

Journals: Hydraulics, Power, Professional Practice, Sanitary Engineering, Structural, Surveying and Mapping.

2698. Status of State Registration Laws, by William M. Spann. (PP) The development and importance of registration laws for engineers in the United States is considered.

2699. Meaning of the Professional License to Engineers, by Donald Kowtko. (PP) This paper presents the results of a survey outlining the tangible and intangible forces that motivate engineers toward obtaining their annual professional license.

2700. Hydrogeologic Nature of Streamflow on Small Watersheds, by J. L. McGuinness, L. L. Harrold, and C. R. Amerman. (HY) The importance of watershed area in depth-area-duration-frequency relationships on streamflow from small watersheds is considered. The interrelationships between the geologic and hydrologic aspects are presented.

2701. Chlorination of Mixed Sewage and Storm Water, by Thomas R. Camp. (SA) This paper concerns the effective use of screening and chlorination of raw sewage and storm water by pollution control agencies.

2702. Surveys for the Lake Pontchartrain Bridge, by James M. Tuttle. (SM) The overall survey control for the Lake Pontchartrain Bridge and the challenging problems prior to and during construction are considered.

2703. Static and Dynamic Analysis of Guy Cables, by Donald L. Dean. (ST) Guy cables are analyzed for static and dynamic conditions, and examples are solved to illustrate the formulas derived.

2704. Lateral Inelastic Buckling of Tied Arches, by Chin Fung Kee. (ST) The behavior of the tied or stabbogen arch in the light of existing inelastic buckling theories is examined, and a theoretical method for computing the inelastic buckling load is produced.

2705. Highway and Bridge Surveys: Construction Surveys, Progress Report, Committee on Engineering Surveying of the Surveying and Mapping Division. (SU) This report deals with the design of triangulation systems, the location of control stations, and base lines.

2706. Frequency of Natural Events, by H. C. Riggs. (HY) This paper examines the development of a cumulative frequency curve and its relationship to magnitude.

2707. Underground Outlet Works for Courtright and Wishon Dams, by J. B. Cooke and J. E. Schumann. (HY) The diversion and outlet works for the Courtright and Wishon Dams are explained in this paper.

2708. Some Aspects of Surface Water Wave Scale Effects, by Gerrit Abraham. (HY) A study of the scale effects due to surface tension for model studies of water gravity waves generated by moving pressure disturbance is presented.

2709. Electronic Computer Use in Scoping Power Projects, by Parker R. Grimes and Glenn H. Von Gunten. (PO) A summary of successful computer applications in planning and design of lower Columbia and Snake River power developments is presented.

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(SA) Sanitary Engineering
(SM) Soil Mechanics and Foundations
(ST) Structural
(SU) Surveying and Mapping
(WW) Waterways and Harbors

PROCEEDINGS AVAILABLE

2710. Prototype Measurements of the Columbia River Estuary, by John B. Lockett and Harold A. Kidby. (HY) Modern methods of measuring flow characteristics of the extremely complex Columbia River entrance system define the environmental conditions affecting the problem of shoaling in the entrance area and reveal phenomena that appear to have important significance relating to this problem.

2711. Hydraulic Computations from Limited Information, by Cecil K. Oakes. (HY) The author describes methods, together with sample results, recommended for use in certain types of hydrologic and hydraulic computations in which lack of time and/or funds will not permit obtaining additional basic data and information.

2712. Analysis of Structures by Combining Redundants, by Peter P. Gillis and Kurt H. Gerstle. (ST) The method of analysis of elastic structures that avoids the solution of large systems of simultaneous equations is examined.

2713. Development of a Variable Reluctance Velocity Meter, by Iury L. Maytin. (HY) Presented herein is a new method of measuring fluid flow based on the principle of variable reluctance.

2714. Stress Analysis and Special Problems of Prestressed Dams, by O. C. Zienkiewicz and R. W. Gerstner. (PO) The development and use of cable methods of prestressing as applied to dams is presented.

2715. Recent Trends in Ultimate Strength Design, by Phil M. Ferguson. (ST) This paper considers recent trends of the ultimate strength theory for reinforced concrete members.

2716. Hydraulics of Southwest Pass, Mississippi River, by Chester A. Peyronnin, Jr. (HY) This paper summarizes and generalizes the results of an extensive data collection program at Southwest Pass of the Mississippi River.

2717. Marine Disposal of Wastes, Progress Report, Subcommittee on Specialized Subjects, Committee on Sewerage and Sewage Treatment. (SA) The availability and appreciation of basic knowledge concerning marine disposal of wastes has increased rapidly during the past few years. The expanding interest in the subject is illustrated not only by the literature, but by the number of symposia and conferences that have been held.

2718. Storm Water and Combined Sewage Overflows, by Samuel A. Greeley and Paul E. Langdon. (SA) Most of the larger and older cities in the United States are served by combined sewer systems. The intersection and treatment of the dry weather sewage and the first flushings of storm water has accomplished much toward pollution abatement. Treatment of overflows by retention and chlorination can improve the conditions in the receiving waterway, in some respects, at feasible costs.

2719. Discussion of Proceedings Paper 2383, 2365, 2379. (SU) Edward Adams Richardson on 2383. Alfred W. Fischer on 2365. T. F. Hickerson on 2379.

2720. Discussion of Proceedings Paper 2481, 2558. (SA) Conrad P. Straub and Vincent J. Sodd on 2481. Edward R. Hermann on 2558.

2721. Moment-Distribution Constants from Cardboard Analogs, by Otakar Ondra. (ST) An experimental method of determining moment-distribution and slope-deflection constants for beams with variable moments of inertia is proposed. Simple graphics, especially evolved for the purpose at hand, are used to lay out cardboard templates. Templates areas are evaluated and their centroids are located experimentally. This is equivalent, respectively, to numerical integration and division of one integrated function by another. The method is simple, rapid, and sufficiently accurate for office use.

2722. Discussion of Proceeding Paper 1868, 1869, 1870, 1871, 1872. (PP) The Student Activities Committee, San Diego Section, ASCE on 1868. F. C. Lindvall on 1869. Jack E. McKee on 1870. L. E. Grinter on 1871. C. Ken Weidner on 1872.

2723. Discussion of Proceedings Paper 2206, 2289, 2291, 2515, 2569. (PO) William R. Waugh and James A. Rhodes on 2206. Dante Finzi, Mario Mainardis, and Carlo Semenza on 2289. Robert Bouchayer on 2291. Clark L. White, J. B. Billingsley, Robert E. Hollick, F. W. Rechtermann, C. B. Benham, Harold H. Dugan, Jr. on 2515. Adolf A. Meyer on 2569.

2724. Discussion of Proceedings Paper 2081, 2085, 2128, 2129, 2147, 2148, 2149, 2150, 2200, 2201, 2202, 2224, 2242, 2370, 2469, 2478, 2484, 2485, 2525, 2526, 2531, 2546, 2551. (HY) Henry M. Morris on 2081. Paul C. Mayer on 2085. Bertram S. Barnes on 2128. Marvin J. Webster on 2129. Phillip Z. Kirpich and Carlos S. Ospina on 2147. M. J. Webster and L. R. Metcalf on 2148. Joe M. Lara and Kenneth B. Schroeder on 2149. G. T. Orlob on 2150. G. L. Bleichley and A. J. Peterka on 2200. Charlie M. Moore on 2201. P. S. Eagleson and R. G. Dean on 2202. James W. Ball on 2224. William R. Ferrell on 2242. R. C. Kolf and P. B. Zielinski on 2310. Chesley M. Posey, Monir M. Kansoh, Serge Leliavsky on 2469. Ernest Flack, Harold W. Humphreys, E. T. Smerdon, R. P. Beasley and L. D. Meyer on 2478. Gerald Lacey, Peter Ackers, G. Kalkanis, John F. Kennedy, T. Blench, Claude Inglison on 2484. H. A. Einstein, T. Blench, Emmett M. Laursen and Gerald A. Zernial, Dasal E. Hallmark, Thomas Massock, Jr. and W. B. Langbein, R. Hugh Taylor, Jr. and Norman H. Brooks, Lucien M. Brush, Jr. on 2485. Russel Woodburn, T. Blench on 2525. Emmett M. Laursen, Egidio Irdi on 2526. Melville S. Priest, Milton A. Chapple, R. C. Kolf and W. L. Meyer on 2531. W. D. Baines on 2546. M. E. Harr, Raphael G. Kazmann, W. T. Moody, K. T. Sundara Raja Iyengar on 2551.

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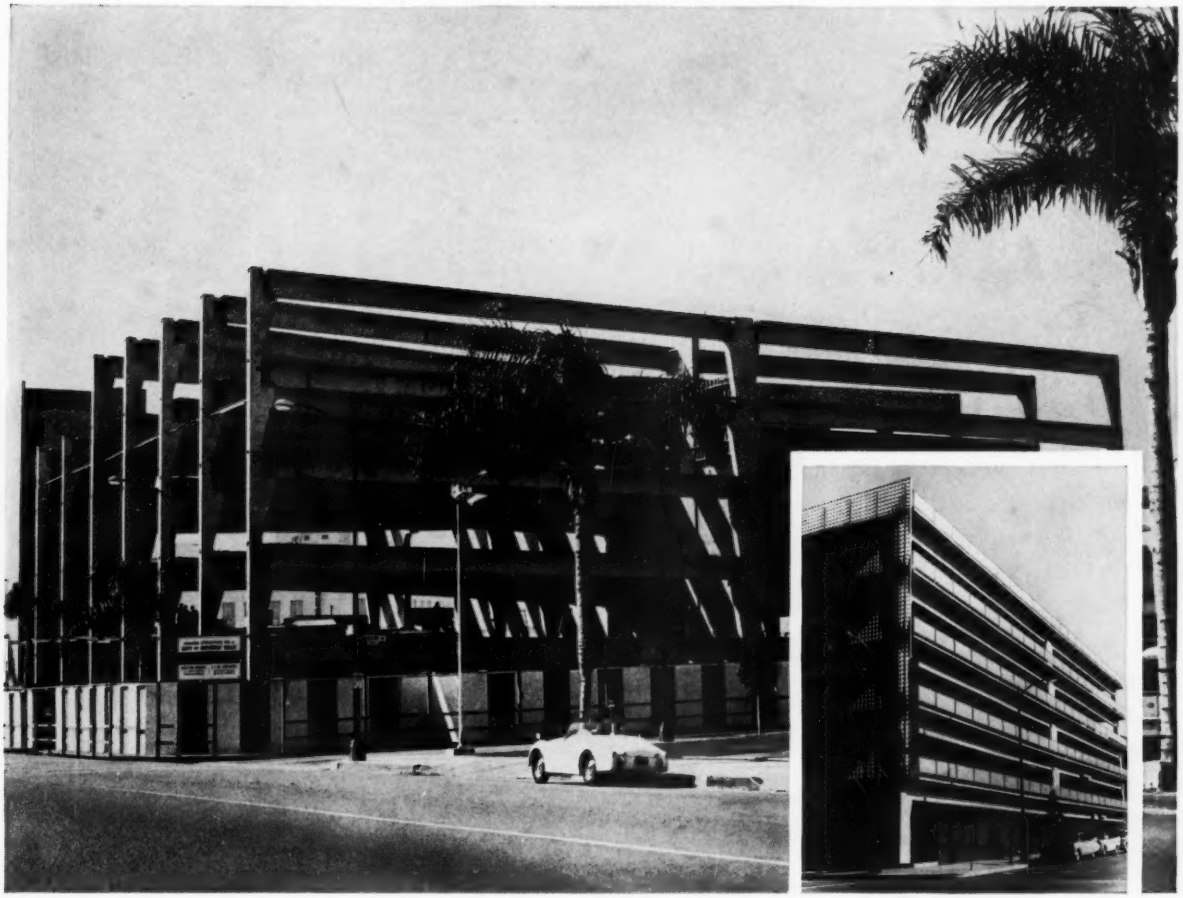

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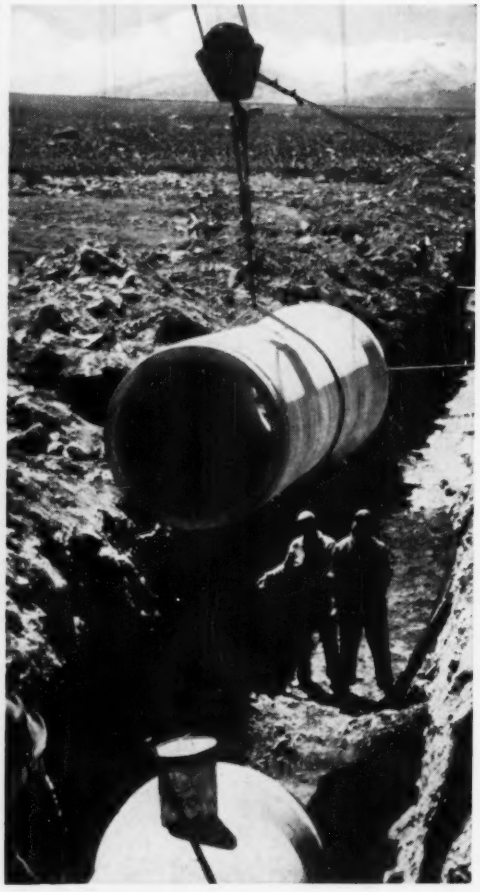

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